13
including
St. Peter's
Library

J. E. V. BOAS & SIMON PAULLI

THE

ELEPHANT'S HEAD

STUDIES IN THE COMPARATIVE
ANATOMY OF THE ORGANS OF THE
HEAD OF THE INDIAN ELEPHANT
AND OTHER MAMMALS

PUBLISHED AT THE COST OF THE CARLSBERG-FUND, COPENHAGEN

FIRST PART

THE FACIAL MUSCLES AND THE PROBOSCIS

WITH SEVENTEEN PLATES IN COLOURS

SOLD BY MR. GUSTAV FISCHER, JENA

1908

THE ELEPHANT'S HEAD

GL
737
P98
B66
1908, p. 1
SCHW23

PREFACE.

IN the year 1896 the Zoological Gardens of Copenhagen received a young Indian Elephant lame in one hind-leg, the femur having been dislocated during the capture of the animal. It lived nearly three years in the gardens, but then the authorities of the institution decided, on account of the creature's lameness, and its consequent distressing appearance, to have it killed, and to hand over the body to the Zoological Laboratory of the R. Veterinary and Agricultural College, of which laboratory one of us is the curator. The live animal was accordingly transported to the College, where, after an injection of morphia it was chloroformed. In concordance with previous experiences of others the animal showed none of the violent reactions to the chloroform so general in many animals before the narcosis. During the narcosis the head and neck were separated from the body as near the thorax as possible, and immediately after removal were injected with a four per cent solution of formaldehyde, through the carotids. It was then placed in the usual freezing mixture (salt and ice) for forty eight hours; after which it was carried into a saw-mill, and by means of a band-saw was divided sagittally into halves. The conservation, and the freezing, proved excellent; and the section-plane had a rather good course. It may also be noted here, that the animal, in all respects, — the luxation in the hip-joint excepted —, appeared to be quite healthy; the material thus being in a first-rate condition. The head has since been preserved in formaldehyde¹⁾.

It is with an investigation of this head that the present work has started; of which herewith the *First Part* is issued, which deals with the *Proboscis* and the *Facial Muscles* of the Elephant. The treatment of these muscles has been decided upon from a desire to establish the homology of the muscles which take part in the formation of the proboscis of the Elephant — what has been the departure of the whole work. But with this object in view we were naturally induced to take up the study of the whole of the facial muscles of the Elephant and this again of some necessity led us into a comparative study of the facial muscles of the *Mammals generally*. The results of the last-named investigation we have laid down in the first paragraph of the present work. It has in this place been our principal aim to establish the *General scheme* of the facial muscles of the Mammals and to have a synopsis of the whole subject, as plain as possible. To attain this end we have studied a number of forms of various groups of Mammals, the majority of the »orders« having been investigated in one or — generally — more representatives²⁾. Although we are well aware, that very much work must be done before the matter is exhausted, we venture to hope that the plain scheme, to which we have arrived through our rather extensive — but in the individual object nevertheless quite intensive — studies, shall in the main prove to be settled. As to the origin of the whole of the facial muscles and their derivation from what is found in the lower Vertebrates — a

¹⁾ Besides we have had at our disposal the trunk of another young Elephant, which in 1890 died in a circus in Copenhagen; and a fragment of the head of an Elephant, which has been got in exchange from Prof. Stross in Munich.

²⁾ The major part of the material has been obtained in the course of time from the *Zoological Gardens* of Copenhagen, to which institution we are largely indebted. Some few forms we have ourselves collected or purchased, or obtained through the benevolence of our colleague, the celebrated Mammalogist of Stockholm, Prof. W. LECHE, to whom we express our best thanks.

matter which has in the first instance engaged the attention of our most honoured predecessor GEORG RUGE — we have only touched upon this side of the subject.

In the next paragraph we have treated of the facial muscles of the *Elephant*, which we have gone through in a detailed manner on the basis laid down in the foregoing paragraph. Of special interest may perhaps be our treatment of the muscles of the proboscis, in which is demonstrated, that the singular muscles of this organ may all be derived from muscles present in other Mammals; also the details of structure and arrangement of some of these muscles may possibly lay claim to some interest, being rather unique of their kind. — The results of the study, which, of course, in connection with our examination of the facial muscles, we have made of the *nervus facialis* in the Elephant and other Mammals, we intend to publish in the next part of this work, in which we shall also discuss the significance of the nervous system for the comparative study of the muscular system.

In a third paragraph the relation of the *proboscides* to the *snout* of ordinary Mammals is discussed. It is here pointed out, in what way they are derived from the latter. Furthermore it is made out, that the proboscis of the Elephant and of the Tapir occupy a separate place among the proboscides, which in most Mammals are principally *tactile organs*, while in the said two forms they are *prehensile organs*, to which difference in function also corresponds a substantial difference in structure.

The external form, under which our work appears, has essentially been determined by the subject. It was for a presentation of the facial muscles of an animal of the size of the Elephant of a certain importance to have the size of the plates larger than usual. That we have chosen to have the figures in colours certainly need no apology; the understanding of the object in this way will greatly be facilitated. Upon the whole we have taken great pains to bring the subject within easy reach of our readers.

The drawings have been made under our direction by the well-known excellent draughtsman Mr. C. CORDTS, to whom, for his part of the work, we are greatly indebted.

As to the language we have had the privilege of having the text supervised by two English colleagues, Dr. FORSYTH MAJOR and Mr. W. P. PYCRAFT, to which gentlemen we express our best thanks, as also to Mr. JAS. GILCHRIST, who has had the goodness to read over the proof-sheets.

The publication of this work in the present form would not have been possible without the existence of the *Carlsberg-Fund*, to whose administrators we express our sincere thanks for the liberal grant they have voted to our work.

As to the *continuation* of our work: To the account of the facial muscles we join in the *second part* — which is already rather advanced — a treatment of the *facial nerve* of the Elephant and of some other Mammals. In the same part we intend to deal with the *ear-cartilage* of Mammals, on which subject one of us has already published a preliminary notice. In further parts we hope to treat of other points of the anatomy of the head.

CONTENTS.

	PAGE
PREFACE.	
THE FACIAL MUSCLES OF MAMMALS GENERALLY.....	5
1. Platysma-sphincter-group	6
2. Orbicularis-oculi-group	10
3. M. maxillo-labialis	12
4. Buccinator-group	13
5. M. lateralis nasi	15
6. Mm. recti nasi et labiorum.....	16
7. Muscles of the external ear	16
A. In Placentals with a scutellum	16
B. In Marsupials	20
C. In Placentals without a scutellum	21
D. In Monotremata	22
8. Concluding Remarks	23
THE FACIAL MUSCLES OF THE ELEPHANT.....	25
1. Platysma-sphincter-group.....	25
2. Orbicularis-oculi-group	28
3. M. maxillo-labialis	30
4. Buccinator-group	33
5. M. lateralis nasi	39
6. M. rectus nasi	40
7. Muscles of the external ear.....	43
THE PROBOSCIS	47
APPENDIX: Facial muscles of some Ungulates.....	51
Camel.....	51
Elk	54
Wapiti	58
Zebu	60
Boar	63
Tapir	66
Horse	71
INDEX	75

THE FACIAL MUSCLES
AND
THE PROBOSCIS

A.

THE FACIAL MUSCLES

OF

MAMMALS GENERALLY.

IN the history concerning our knowledge of the facial muscles of Mammalia, the works of GEORG RUGE mark a new era, their starting-point being an actually and designedly comparative one: the comparative aim being pursued with all consistency: and coupled with the greatest care in investigation. Unfortunately the papers of RUGE only deal with Prosimiae and Primates, which groups he worked out first; and the Monotremata, which he dealt with later on. Of the other orders of Mammalia no such investigations of the facial muscles are on record. Even in the domesticated mammals, whose anatomy — next to that of man — has been dealt with in the most thorough manner, the facial muscles have not been treated in this way. The papers of RUGE as we have said only deal with a few groups of Mammals; and these groups being very distant from the Elephant, we have found it necessary to work out, on similar lines, the facial muscles of a series of Mammals of various groups in order to form a somewhat broader basis, from which we might estimate the facts which we found in the Elephant. The more comprehensive material thus at our command — viz. the investigations of RUGE and those of ourselves — have naturally led us to results, in some points differing from RUGE¹⁾, which differences will be evident from what is communicated in the sequel.

The Mammals, whose facial muscles in a more or less complete manner are examined by us, are the following: *Echidna*, *Ornithorhynchus*, *Hatmaturus*, *Didelphys*, *Centetes*, *Erinaceus*,

Talpa, *Myogale*, *Lepus*, *Myopotamus*, *Canis*, *Nasua*, *Alces*, *Cervus canadensis*, *C. Aristotelis*, *Bos*, *Camelus*, *Sus*, *Tapirus*, *Equus*, *Lemur*, *Nycticebus*. The types, whose names are italicized, are those which we have examined in the most complete manner.

A general survey of the facial muscles of Mammals may be made in grouping them in the following manner.

1. PLATYSMA-SPHINCTER-GROUP.

On the ventral and lateral hinder part of the head (the region below the outer ear and further forward) and on the neighbouring parts of the neck is developed a *three-layered* complex of muscles, consisting of a superficial, transverse layer, which we designate the *sphincter superficialis*, an intermediary, longitudinal layer, the *platysma*, and a deep, transverse layer, the *sphincter profundus*. These three muscle-plates are generally all present, but often the sphincter superficialis is restricted to the neck alone, not reaching the head.

The **sphincter superficialis** (Pl. 17, fig. 1) is in many forms a true sphincter, the right and left part of the muscle running ventrally into each other. It is most powerfully developed in *Echidna* (Pl. 10, fig. 1, 2) and *Ornithorhynchus*, where it forms a continuous muscular plate underneath the neck and the head, proceeding unto a line from the outer ear to the angle of the mouth. Similarly, in *Centetes* (fig. B) it is a very strong muscle,

¹⁾ For the sake of comparison with the results arrived at through our investigations and exposed in the sequel, we summarize here the principal points of the view of the facial muscles set forth by RUGE in his paper: Über die Gesichtsmuskulatur der Halbaffen, in: Morphol. Jahrb. 11. Bd.:

The whole of the facial muscles is differentiated from two muscles, both originating from the neck, viz.

I) a superficial layer, *platysma myoides*.
II) a deep layer, *sphincter colli*.

From the *platysma* RUGE derives the following muscles:

1) *M. auriculo-occipitalis* = m. auriculo-occipitalis nob., from which again a deep layer is split off: *M. auricularis post.* = m. postauricularis nob.
2) *M. auriculo-labialis inf.* = m. adductor infer. nob. From this is derived the *m. trago-antitragicus* = m. posteri septimi nob.
3) *M. mentalis* = m. mentalis nob.
4) *M. auriculo-labialis sup.* = m. postorbicularis nob., from which the following muscles are derived:
a) *M. orbicularis oculi* = m. orbicularis oculi nob., from which the *m. levator labii* (= m. nasolabialis nob.) originates.

b) *M. depressor helcis* = m. scutularis, ventral portion, nob.

c) *M. helcis* = m. anteri sexti nob.

d) *M. orbito-auricularis* = m. scutularis nob., from which again are derived the *m. auricularis sup.* (= pars transiens nob.).

From the *sphincter colli* (= m. sphincter profundus nob.) RUGE derives the following muscles:

1) *M. depressor tarsi* = portio palpebralis m. sphinct. profundi nob.

2) *M. orbicularis oris* = pars rimana m. buccinatorii nob.

From the last are derived:

a) *M. caninus* = part of pars rimana nob., inserting into the maxillary bone.

b) *M. uasalis* = m. nasalis nob.

c) *M. maxillolabialis* = m. maxillolabialis nob.

d) *M. buccinatorius* = m. buccinatorius nob.

Finally RUGE enters the *m. mandibulo-auricularis* (= m. temporo-auricularis nob.) as a muscle independent of the system of facial muscles; his motive of this opinion is that he has not been able to find a branch of the n. facialis to the muscle, which he is of opinion is innervated by a branch of u. trigeminus and therefore should be regarded as standing in nearer relation to the masticatory muscles.

and in the *Dog* (Pl. 12) it is even rather well developed; in both, the cervical part of the muscle is the strongest, the cephalic part not extending far forward and upward. In *Myopotamus*, where it is rather thin, it is far extended on the face, as far as the angle of the mouth. In *Sus* (Pl. 9) the muscle, which is rather bulky, is present only on the neck, extending on to the angle of the lower jaw; an anterior, narrow portion extends below the platysma and on to the *inner* side of this muscle, and a few fascicles thereof are directly continued into the sphincter profundus (Pl. 10, fig. 3); the greater, posterior, part of the muscle, as usual, lies on the *outer* side of the platysma. In other *Ungulata* it is also restricted to the neck, not extending on to the head. In the *Marsupials*, the *Prosimiae* and *Primates*, it is not present (at most in the *Prosimiae* there may be traced vestiges of it).

The **sphincter profundus** when most completely developed extends forward to the anterior extremity of the head; upward it extends to the eye, and the ear (Pl. 17, fig. 2). The *hindmost* part is inserted into the tragus of the auricle, acting as a depressor of the ear, *portio auricularis*. A *middle* portion of the muscle extends into the lower eyelid, acting as a depressor thereof: *portio palpebralis*. The part of the muscle which connects these two portions we term *portio intermedia*. Finally there is a front part of the muscle, the *portio oris*, generally termed *musc. orbicularis oris*¹). The fibres are here curved in such a manner, that they more or less perfectly surround the cleft of the mouth. The direction of the fibres in the rest of the muscle is mainly transverse, but in the hind part of the muscle the direction is ventrally more antero-posterior; and sometimes these fibres are inserted into the anterior end of the sternum. Ventrally the transverse bundles of the right and left muscle are sometimes directly continued into one another, or the bundles may cross one another, or they may be separated in the middle line by a linea tendinea, or they fail to reach one another, or parts of the muscles may behave in one, parts in another manner in the same animal.

A *complete* development of the muscle as just described is not found in many Mammals. The *portio oris* we know only in the *Dog* and the *Rabbit*. The *portio intermedia* has often been suppressed, the *portio palpebralis* and *auricularis* thus representing two distinct muscles.

As a continuous muscular plate, extending from one end of the head to the other, the muscle is developed in the *Dog* (Pl. 15, fig. 2). The *portio oris*, which extends round the angulus oris into the upper and lower lip (but not to the anterior end thereof), proceeds posteriorly in the following part of the sphincter, the fibres lying in the same plane and becoming gradually less curved, and more transverse; thus passing over into the *portio palpebralis*, which is large and intimately connected with the orbicularis oculi. The *portio auricularis* is very distinct, the *portio intermedia* being thinner and composed of more loosely connected bundles.

In the *Prosimiae* the sphincter profundus is a continuous rather well developed thin plate, but an insertion into the auricle does not always take place, and the *portio oris* is not present, or at most only a few fibres are continued into the upper lip²).

In the *Rabbit* the sphincter profundus extends as a continuous plate from the anterior end of the sternum, from which a part of its fibres takes origin, unto the angle of the mouth. A powerful *portio auricularis* is present, but the *portio palpebralis* does not reach the orbicularis oculi. The *portio oris* extends only into the upper lip.

In the following forms there is *no portio oris*; the sphincter does not extend so far forward on the face.

In *Centetes* (fig. C) and *Halmaturus* (Pl. 15, fig. 2) the sphincter profundus is well developed, and continuous; the *portio auricu-*

¹) Not every muscle, which is termed »*musculus orbicularis oris*«, is the *portio oris* of the sphincter prof. In most Mammals the »*m. orbicularis oris*« is wholly, or in part, a portion of the buccinator (v. below).

²) What RUGE (Gesichtsmusk. d. Halbaffen, in: Morph. Jahrb. 11. Bd.) terms the *orbicularis oris* (and the *caninus*) in the *Prosimiae* is the superficial transverse layer of *m. buccinatorius*, behaving in a quite similar manner as the corresponding part of the *Dog* and *Hedgehog*; in the figures of RUGE it appears as if his *orbicularis oris* and *caninus* were a direct continuation of the sphincter profundus — but we have not found it so. Comp. the description of the *m. buccinatorius*, hereafter.

laris is connected with the ear; the *portio palpebralis* extends, in *Halmaturus*, generally unto the orbicularis oculi and is inserted into it; but in *Centetes*, and in one of the specimens of *Halmaturus* examined, it does not reach the orbicularis. In *Centetes* the bundles of the hinder part of the muscle ventrally meet the corresponding muscle of the other side in a tendinous line, whereas the bundles of the greater anterior part of the muscles are directly continued from one side to the other. In *Myopotamus* the muscle is very strong, the caudal end thereof being connected with the front end of the sternum; the hindmost part of the muscle, as usual, forms a fleshy *portio auricularis*, but further forward the dorsal part of the muscle is represented by an aponeurosis, the fleshy part of the muscle being situated for the most part ventrally.

In the *Ungulata* generally the *portio intermedia* has totally disappeared, the *portio auricularis* and the *portio palpebralis* being quite separated; at most a small part of the *portio intermedia* has been preserved in connection with the *portio auricularis*. In all the *Artiodactyla* examined by us (viz. *Sus*, *Camelus*, *Alces*, *Cervus canadensis* and *Aristotelis*, *Bos*) both the said portions are well developed. In the *Elk* (Pl. 15, fig. 6) the *portio auricularis* is a true sphincter, whose anterior bundles run as an arch from one auricle to the other below the neck; the hind bundles radiate like a fan on the underside of the neck, in the middle line crossing those of the other side. In *Cervus Aristotelis* the very well developed *portio auricularis* is not a true sphincter, the bundles in the middle line being separated from those of the other side by a tendinous line. In this species there is a distinct remnant of the *portio intermedia*, attached to the front margin of the *portio auricularis*, extending a little on the surface of the masseter. In the *Perissodactyla*, viz. *Tapir* and *Horse*, the *portio palpebralis* is only slightly developed, in the *Tapir* (Pl. 7) being connected with the buccinator (Pl. 8, fig. 2), of which it is in this animal apparently a detached portion; in the *Horse* (Pl. 8, fig. 1) it is a very thin weak muscle, the ventral ends of whose bundles are directed somewhat more forward than usual; in both animals the portion is connected with the orbicularis oculi. The *portio auricularis* in the *Tapir* (Pl. 7) is partially a true sphincter, the *hind* bundles forming a sling from one ear to the other; in the *Horse* there is no such connection.

In *Echidna* (Pl. 10) the muscle presents rather striking peculiarities. Only the hind part of it, behind the ear, is developed; it is in the usual manner attached to the ear-conch, but is much larger than the *portio auricularis* of other Mammals, being a powerful muscle extending beyond the median side of the fore-limb and on the ventral side of the trunk, where it is connected with the cutaneous muscles of the latter. A point of great interest is that the *sphincter profundus* and the *sphincter superficialis* in *Echidna* ventrally run into one another (Pl. 10, fig. 2), so that both, to some extent, form one muscle, with a deep cleft, in which the platysma has its place¹). This arrangement in a form such as *Echidna* makes it rather probable that the two sphincteres were originally *one* muscle: there seems to be no reason to suppose that the connection of the *sphincter superficialis* and *profundus* in *Echidna* is a secondary one²).

In *Ornithorhynchus* there is no sphincter profundus.

The intermediary sheet of our complex is the **platysma** (Pl. 17, fig. 1), whose bundles have chiefly, and markedly, a *longitudinal* direction. It is always present. *Primarily* it is a great continuous muscular plate extending from the neck to the angle of the mouth or still further forward; occupying the side of the head below the eye and the ear (seldom extending above them). But it may be transformed in various ways: sometimes either the hind or the front part of the muscle has been reduced to an aponeurosis, the front or the hind part of the muscle respectively being muscular; and instead of being continuous the muscle may have been split in two or more portions,

¹) In the individual examined an aberrant bundle from the sphincter prof. extends on the outer surface of the platysma (a Pl. 10, fig. 1—2).

²) Comp. also the singular connection of some fibres of *sphincter superficialis* with the *auricular* portion of *sphincter profundus* in *Sus*. (p. 7).

Fig. A. Superficial facial muscles of *Didelphys*.

Fig. B. Superficial facial muscles of *Centetes*. — *a, b, c* comp. p. 22.

Fig. C. Deeper facial muscles of *Centetes*. — *a, b, c, d* comp. p. 22.

one of which appears as the principal platysma. The platysma may be a pure cutaneous muscle, but sometimes parts of it are connected with certain of the underlying bones.

In *Echidna* (Pl. 10) the muscle is more powerfully developed than in any other Mammal; extending not only under the ear and the eye, but also above the ear, where it meets the corresponding muscle of the other side, and posteriorly being continued into the cutaneous muscle of the back of the trunk. The part of the muscle lying above and behind the external ear is very thick and studded with the deep follicles of the spines of that part of the body. Most of the bundles have the usual, longitudinal direction, but in the part of the muscle which is placed before the auricle the bundles have a more oblique direction. The post-auricular part of the muscle is continued below the ear into a rather narrow band, which extends forward and is inserted on the superior maxilla below the eye. The præauricular portion of the muscle extends below the eye and is here, ventrally, intimately connected with the postauricular portion and also inserted on the superior maxilla; dorsally and in front, it is intimately connected with, or rather continued into the orbicularis oculi (comp. below).

In *Ornithorhynchus* also the platysma forms a large muscular plate extending from the fore-limb to the angle of the mouth, but the greater part of the muscle here lies *below* the ear-opening. The lower parts of the muscle end in the skin ventrally, the upper parts are inserted on the maxillary bone. The part of the muscle lying between the eye and the ear (which two are only separated by a very short distance) is very small.

In *Hatmaturus* (Pl. 13, fig. 1) the platysma is a continuous, strong, muscular plate; extending from the neck to the angle of the mouth, reaching dorsally very nearly to the external ear. In *Didelphys* (fig. A), *Centetes* (fig. B) and the *Dog* (Pl. 12) the muscle is similarly developed as a strong muscular plate, extending from the neck, below the ear, to the angle of the mouth. — In *Myopotamus*, in which the platysma is still a continuous muscle, the muscular fibres only extend a short way upon the head (on the hind part of masseter), the front part of the muscle being represented by an aponeurosis extending further upon the face; the hind part of the muscle, lying on the neck, forms a rather strong muscular plate.

In the *Ungulata* (Pl. 5, 7, 9) the dorsal part of the platysma has generally been separated from the major part of the muscle as a fleshy band, which takes its origin from the zygoma, and runs to the angle of the mouth. We term it the *pars zygomatica platysmatis* (musc. zygomaticus autt.). In *Ates* the *pars zygomatica* and the rest of the platysma, *pars principalis*, at the fore-end, near the angle of the mouth, to the extent of a couple of cm, are closely united, so that it is impossible to point out any limit between them; the fibres of the *pars principalis*, which is a rather narrow band on the lower part of the side of the head, have a longitudinal direction. In all other Ungulata examined by us the *pars zygomatica* and the *pars principalis* are separated throughout their whole extent. In the *Camel* (Pl. 5) the fibres of the *pars zygomatica* have the same direction as in the *pars principalis* (which is a broad band of longitudinal fibres) and the front ends of both are inserted into the buccinatorius. In both the hind end of the muscle is represented by an aponeurosis, that of the *pars zygomatica* connected with the zygoma, and that of the *pars principalis* extending from the angulus mandibulæ round the neck. But in most Ungulata the direction of the fibres in the two parts is not quite the same and they may cross each other under obtuse angles (Tapir, Pl. 7, etc.) and behave as muscles which have nothing to do with each other. In *Sus* (Pl. 9) the upper part of the *pars principalis* spreads like a fan on the face, below and behind the eye: and this feature is still more marked in some of the Ruminants; for instance *Bos*, where this part of the muscle is dissolved into a number of disconnected thin and narrow muscular bands spreading over the face.

In the *Primates* there is, as is well known, a muscle very similar to that which we have termed the *pars zygomatica platysmatis* in Ungulata. This muscle — *musculus zygomaticus* —

has, according to RUGE¹⁾, been derived from the m. auriculo-labialis superior of the Prosimiæ, and we think he is quite right in this. The m. auriculo-labialis sup. of the Prosimiæ is our m. postorbicularis. As we must derive our *pars zygomatica* in the Ungulata from the platysma, it is probable that it has been developed from other elements than the similar muscle in Primates. As we shall see later on, some muscles which in various other Mammals have been termed »musculus zygomaticus» have also an independent origin.

2. ORBICULARIS-OCULI-GROUP.

The group of muscles, which we term the *orbicularis-oculi*-group (P. 17, fig. 1; Pl. 16, fig. 20—27) consists firstly of the well-known muscle surrounding the opening between the eye-lids: secondly of several other muscles, which evidently are derived from the orbicularis. The orbicularis itself has, as is also insisted on by RUGE, probably been derived from the platysma, to the dorsal margin of which its ventral part fits in in such a manner in *Echidna*, that it has quite the appearance of their being of one set.

As to the *orbicularis* proper; the fibres composing it in the forms which we have examined, generally do not wholly encircle the palpebral fissure. In the Ungulata, which we have principally studied in this connection, they are always interrupted at the front angle of the eye by the front palpebral ligament. Sometimes, as in the Horse (Pl. 16, fig. 26), the fibres with this exception go all round the eye; but generally a number of them have a more limited extension: 1) some only lying in the upper lid cross others only lying in the lower lid at the posterior angle of the eye (Camel, Pl. 16, fig. 21); 2) fibres lying principally in the upper lid go from this round the posterior angle into the lower lid but not wholly round to the anterior canthus (Zebu, Wapiti, fig. 23—24); 3) fibres lying principally in the lower lid go round the posterior canthus into the hind part of the superior eyelid (Alces, fig. 22); 4) some fibres go from the anterior canthus only a short way into the lower (fig. 23—24), resp. the upper eyelid; 5) some fibres only encircle the posterior angle of the eye (fig. 27).

From such incompletely developed parts of the orbicularis-fibres the *annexed muscles* of the group are derived. From fibres encircling only the posterior angle of the eye (5) is derived the *musculus postorbicularis*, a muscular plate whose fibres sometimes have a similar direction to those of the orbicularis proper (Tapir, Pl. 16, fig. 27), but generally have taken a more transverse (dorso-ventrad) direction. The muscle is in some Mammals of considerable size, sometimes being very broad as in the *Didelphys* figured (fig. A), in others being far extended dorsad and ventrad as in *Centetes* (fig. B). Sometimes the fibres have been divided transversely (Horse, Pl. 16, fig. 26), the muscle being thus separated into a dorsal and a ventral portion.

In *Bos*, *Ates* (Pl. 16, fig. 22), *Wapiti* (fig. 24), *Dog* (Pl. 12) at the hind angle of the eye there lies a little narrow flat muscle, *m. horizontalis* nob., consisting of longitudinal fibres, taking its origin in the fascia of the m. temporalis. As to the homology of this muscle we waver. The muscle has much the appearance of an intruder into the orbicularis-group, belonging to quite another system than the rest of the orbicularis, and we have for a time been inclined to think, that it was a detached piece of muscle belonging originally to the *scutularis*-group. But the *superficial* position of it goes against this supposition, the scutularis lying always *inside* the postorbicularis, if extending into the part of the face occupied by this muscle; while the m. horizontalis lies *outside* the postorbicularis. Perhaps the horizontalis consists of orbicularis-fibres which have taken a deviating direction; sometimes (comp. the upper fibres in the diagram of the Wapiti, Pl. 16, fig. 24) some of the fibres have a direction, reminding one somewhat of that of the orbicularis-fibres, which might support this supposition.

At the anterior canthus, parts of the orbicularis, in a similar but more complicated manner than at the posterior canthus, have formed annexed muscles. In *Echidna* (Pl. 10, fig. 1), fibres lying before and intimately connected with the orbicularis proper form a flat muscle in front of the eye: *m. præorbicularis*; the fibres are

¹⁾ Gesichtsmuskulatur d. Primaten. Leipzig 1887. p. 61.

principally transverse, but at the upper end they expand like a fan, the posterior fibres extending above the eye. In the other Mammals which have been closer examined the muscle was found to have become separated into several muscles.

Firstly most of the fibres in front of the eye have been divided transversely by the anterior palpebral ligament; the præorbicularis being thus separated into a *præorbicularis dorsalis* and *ventralis*; sometimes however some bundles go from one into the other (Horse, Pl. 16, fig. 26). From the palpebral ligament the fibres of these muscles extend respectively dorsad and ventrad, close to the orbicularis proper, being a direct continuation of this; the fibres having principally a transverse direction, generally spreading like a fan respectively dorsally and ventrally. Posteriorly the *præorbicularis dorsalis* may be continued into a *m. supraorbicularis*, which sometimes (*Elk*, *Camel*, *Swine*, Pl. 16, fig. 22, 21, 25) is a direct caudad continuation of the *præorbicularis dorsalis*; the fibres have a similar direction like the posterior fibres of the *præorbicularis dorsalis*, viz. oblique, the lower ends, which are attached to the orbicularis, being foremost. In other cases the *supraorbicularis* has been more completely differentiated from the rest of the *præorbicularis dorsalis*; in the *Horse* (Pl. 16, fig. 26) for instance it has become rather sharply separated, and in the *Tapir* (fig. 27) it has become displaced so as to take place inside the *præorbicularis*. The same is also the case in *Bos* (fig. 23), where the *supraorbicularis* has assumed an extraordinary development, extending backward over the whole frontal plane, the direction of the fibres posteriorly being longitudinal.

The *præorbicularis ventralis* is in some forms feebly developed (*Didelphys*, *Centetes*, fig. A, B), in others it is a rather large muscle (e. g. *Bos*, Pl. 16, fig. 23). In *Alces* (fig. 22) it is very large and divided into two portions, a hind portion (*prv* 2) behaving as usual, and a front portion (*prv* 1) arising from the lacrymal bone and extending downwards like a fan; it is covered partially by the first-named portion, with which it is intimately connected.

From the *præorbicularis* is also derived the **m. nasolabialis** (Pl. 17, fig. 1). In *Echidna* it is not yet separate from the *præorbicularis*, with which it is also intimately connected in several of the others. The fibres of this muscle have generally an oblique direction, the ventral ends, which extend into the upper lip and unto the nares, being foremost. Originally (*Didelphys*, fig. A; *Centetes*, fig. B; *Prosimiæ*) the muscle extends a way above the eye; and in *Centetes* this is so far exaggerated, that the muscle extends posteriorly above the ear and further on (this is probably a consequence of the existence of the spinous coat of this animal). But often, as is the case with all the Ungulata examined, the part of the muscle extending above the eye is very little developed. The nasolabialis is generally a muscle of considerable strength, extending often over a large part of the face. In some forms, e. g. the *Camel* (Pl. 5), there is no limit whatever between the nasolabialis and the *præorbicularis*, the former being a direct rostrad continuation of the latter, especially of the *præorbicularis ventralis*; in other forms, as the *Tapir* (Pl. 16, fig. 27; Pl. 7), it is more, but not quite, independent, the caudal fibres still being closely attached to the front margin of the *præorbicularis ventralis*. In the *Horse* (Pl. 16, fig. 26) it is still more independent, and in the *Swine* (Pl. 9) it has been widely separated from the *præorbicularis* through a broad space. — The *Elk* presents the peculiarity, that the right and the left nasolabialis unite above the snout and here form a layer of transverse fibres.

The *Wapiti* (Pl. 16, fig. 24) and the *Zebu* (fig. 23) are peculiar in that a smaller or greater number of the dorsal ends of the fibres of the *præorbicularis dorsalis* turn in a bow, into the nasolabialis, and are continued in the same direction as the fibres of the nasolabialis, forming a smaller or greater part of this muscle. The arrangement is such, that if no other Mammals were known than the *Wapiti* and *Zebu* the natural inference of the facts would be, that the nasolabialis had been derived from the *præorbicularis dorsalis* in such a manner, that the rostral fibres of the latter had grown down in a bow into the upper lip — an inference which the comparison with other Mammals shows to be erroneous.

Generally, the muscle has no definite origin from the bones of the face. But in *Nasua* (Pl. 11, fig. 2) where the inferior ends

thereof are inserted into the tendons of m. maxillo-labialis, and into this muscle itself, it takes a definite origin from the skull in front of the eye, and is here intimately attached to the bone. That it has been developed in this manner in *Nasua* is probably a consequence of the development of a moveable proboscis in *Nasua*; the m. nasolabialis has assumed the part of an auxiliary of the m. maxillo-labialis — the principal motor of the proboscis — and must therefore have a fixed origin. In the *Dog*, where the inferior ends of the nasolabialis are also inserted into the maxillo-labialis, it does not take its origin from the bone but extends in the usual manner in front of the eye loosely connected with the underlying parts.

3. MUSCULUS MAXILLO-LABIALIS.

The *m. maxillo-labialis* (Pl. 17, fig. 3), which is covered by the nasolabialis, appears as quite independent from this and from the other facial muscles; the connection with the «caninus-orbicularis» (front part of sphincter prof.), which Ruge has found in the *Prosimiæ*, we have not found in the forms examined by us, and we can only regard that connection in the *Prosimiæ* as a quite secondary. The muscle takes its origin below, behind and above the foramen infraorbitale and extends into the upper lip and round the external nares. The direction of its fibres is mainly a horizontal one. At the origin the muscle is generally fleshy, but it may sometimes arise with shorter or longer tendinous parts. At the other end it generally terminates in several tendons, but parts of it may also terminate fleshy.

The muscle has a distinct tendency to separate into several portions. More especially we find a very general tendency for this muscle to split into an upper part — the *portio superior* nobis — and a lower part — the *portio inferior*. In *Alces* (Pl. 11, fig. 1) the *portio superior* is still coherent with the rest of the muscle, but the fibres and tendon thereof have another direction than the rest, which direction is oblique, and upward; the numerous branches in which its tendon is ultimately split up, end on the upper side of the nose. In the *Horse* (Pl. 8, fig. 1) and the *Tapir* (Pl. 8, fig. 2) the *portio superior* (the m. levator labii superioris proprius of the Veterinarians) has been entirely separated from the rest through a large interstice, and ultimately it is united with that of the other side and ends at the front end of the proboscis (in the *Tapir*) or in the upper lip (*Horse*). — In the *Camel* (Pl. 11, fig. 4) the *portio superior* has quite disappeared, the maxillo-labialis consisting only of the bundles arising below the foramen infraorbitale (comp. the figure of the Camel and those of the *Tapir* and the *Horse*).

The relation of the maxillo-labialis of *Centetes* to that of *Erinaceus* is similar to that of the same muscle in *Alces* on one side and in the *Horse* on the other. In *Centetes* (fig. C) the *portio superior* is still united with the rest, but on the way to separation. In *Erinaceus* (Pl. 11, fig. 3) the *portio superior* is quite separate (but still borders on the *portio inferior*) and very large, arising from the front margin of the orbit, above and below the entrance to the lacrymal canal; its long tendon joins — as is also the case with *Centetes* — that of the other side above the nasal cartilage and the common tendon is inserted into the skin of the dorsal side of the tip of the nose. The *portio inferior* arises in *Erinaceus* from the zygoma and is divided into four parts which are rather deeply separated. The three superior are each continued into a long tendon, which, as the corresponding tendons in *Centetes*, end in the skin on the side of the nose; the fourth, the inferior, ends fleshy in the upper lip.

In the *Dog* (Pl. 12) there is also an upper and a lower portion, which are quite separated throughout their whole extent; they both arise contiguously below (and behind) the foramen infraorbitale; into the upper margin of the lower portion the inferior ends of the m. nasolabialis are inserted. Towards its anterior end the upper portion is split up into numerous fine tendons terminating behind the external nares, while the anterior ends of the lower portion are fleshy throughout. — In *Nasua* (Pl. 11, fig. 2) the muscle is far stronger than in the *Dog*, and its

origin extends above the foramen infraorbitale. The two portions are fused into one; the part corresponding to the upper portion in the Dog is anteriorly split up into several strong tendons, of which the uppermost, and strongest, is inserted into the hinder end of the nasal cartilage; while the rest are inserted into the skin behind the nostril. That part of the muscle which corresponds to the inferior portion in the Dog ends fleshy, as in this animal.

The *m. maxillo-labialis* of *Talpa* (Pl. 15, fig. 1) is particularly interesting inasmuch as its origin has moved much farther back on the head than in any of the Mammals yet mentioned; the muscle arises from the skull above the bony ear-opening and extends outside the zygoma between the *m. temporalis* and *masseter*, all three muscles forming together one muscular cushion on the side of the head. The muscle is composed of several narrow, loosely connected, muscle-bellies, which may easily be separated by dissection. One of them, which is, as it were, ensheathed by the others, is continued into a strong tendon, which goes to the upper side of the nose; at the posterior end of the cartilaginous nose this tendon is united with that of the other side and is continued as a flat ribbon onto the fore end of the proboscis. Of the other small muscle-bellies the lowermost is continued into the strongest tendon, which goes to the ventral side of the proboscis and ends not far from its tip near that of the other side (but separate). The rest, three in number, are also each continued into a long thin tendon, lying laterally on the proboscis and ending towards its tip¹). (Comp. also the transverse section of the proboscis of the mole, Pl. 14, fig. 1).

In *Echidna* there is no *m. maxillo-labialis*, a lack which may be the consequence of the slight mobility of the snout.

4. BUCCINATOR-GROUP.

The muscles, which we unite under this head, form the bulk of the cheek and the lips.

In *Echidna* (Pl. 10, fig. 1) the group is represented by the *buccinator* muscle alone, whose fibres have a transverse (dorso-ventrad) direction, going from the upper to the lower jaw; the foremost fibres are bent, the convexity to the rear, the upper and lower ends thereof being directed into the lips, which are, as is well known, very feebly developed in *Echidna*.

From a buccinator similar to that of *Echidna* the more complicated conditions found in other Mammals may probably be derived. The *starting point* is as follows (comp. Pl. 17, fig. 3): in the cheek there is found a layer of transverse fibres somewhat bent, the convexity caudad; the ends of these fibres are connected with the upper and lower jaw; the foremost of them have no such connection, but are bent forwards into the upper and the lower lip. But in such simplicity the buccinator is not found in the Mammals apart from the Monotremata; always there are rather considerable complications.

In *Halmaturus* (Pl. 13, fig. 2—3), at a first glance, the conditions appear to be of a primitive character, but on closer inspection we find that here already are complications. The superficial fibres of the buccinator are rather well adapted to the scheme, being transverse; and also deeper lying bundles have the same or a similar direction; but still deeper, near the mucous membrane, there are fibres going at right angles to the others, having thus a more longitudinal direction. Near the anterior end of the muscle the anterior ends of the maxillo-labialis and platysma are inserted into it. The fibres of the buccinator lying outside the ends of the said muscles are those, which are bent into the upper and the lower lip; we term them *pars rimana buccinatorii*. In the upper lip there is still a very large part of buccinator-fibres lying inside the *pars rimana*; these fibres have another direction, viz. transverse (dorso-ventrad): *pars supralabialis buccinatorii* (Pl. 13, fig. 3). — The ends of the buccinator-fibres are on some places inflected, following the mucous membrane and being inserted on the jaws near the teeth; this is the case with the

¹) In *Myogale moschata* the muscle agrees almost exactly with that of *Talpa*; it takes its origin in the same place (above and a little behind the ear), has the same relation to the other muscles and is composed of five small muscular bellies, which all behave as in *Talpa*.

hind part of the supralabialis-bundles and with most of the bundles of the cheek-portion of the buccinator; but other fibres, viz. the front part of the supralabialis and the upper ends of the front part of the cheek-portion, have a simple dorso-ventrad direction, being inserted on the jaw farther above. — Within the *pars supralabialis* lies the *musculus nasalis* (Pl. 13, fig. 3). It is a flat muscle, which takes its origin from the intermaxillary bone, near the teeth, and passes close to the bone upward; it is somewhat expanded at the top, the fibres ending in the skin. In an analogous manner, on the lower jaw, below the incisors, arises the *m. mentalis* (Pl. 13, fig. 3), which also lies close to the bone; from their origin the fibres pass downwards, and somewhat backwards, and terminate in the skin of the lower jaw. Whether these two muscles are differentiated parts of the buccinator or not we are not able to decide. But we think it probable that they are.

As we have mentioned above, in *Halmaturus* some of the deeper fibres of the buccinator have taken another, more longitudinal direction than the rest, which have a transverse direction; a distinct stratification of the muscle has not yet been evolved. In the *Ungulata* (Pl. 16) which we have examined this has gone further, the muscle being universally divided in two, distinct layers, the superficial one of which consists of fibres which have mainly a *transverse* direction, while the deeper layer generally has a *longitudinal* direction; both layers are generally in some places, especially at the hind end, intimately connected. The fibres of the transverse layer may be partially interrupted in the middle by a longitudinal *inscriptio lendinea* (Horse, Pl. 8, fig. 1). Sometimes there may be a third, and deepest layer, partly transverse, partly longitudinal (Zebu, Tapir, Pl. 16, fig. 11, Horse, Pl. 16, fig. 14). Further we note, that from the ventral border of the buccinator some longitudinal, superficial bundles have to a certain degree separated from the rest of the muscle and taken a direction into the median parts of the lower lip: *m. depressor labii inferioris* (Pl. 16, fig. 3, 5, 7, 12, 15). The *pars rimana* is as in *Halmaturus* a continuation of the transverse buccinatorius-layer; but sometimes also the deep, longitudinal layer concurs into the formation of it (Wapiti, Zebu and others). Sometimes (Horse) the *pars rimana* forms a real sphincter, in others the anterior ends of the bundles end in a fibrous median portion of the lips. There is generally a well-developed *pars supralabialis* (Pl. 16, fig. 2, 4, 6 etc.; Pl. 6), consisting as in *Halmaturus* of transverse fibres; it appears generally as a continuation of the longitudinal buccinatorius-layer, whose bundles take a different direction in the upper lip; in *Sus* it is reduced. — The *m. nasalis* is in the *Ungulata* rather strongly developed, being in most Artiodactyla (Pl. 11, fig. 1 and 5) divided into several layers, which take their origin successively from the lower margin of the intermaxillary bone and further above (and sometimes also from the soft nasal wall or from the nasal cartilage); the layers are partly separated by the tendons of the maxillo-labialis. — Also the *m. mentalis* (Pl. 5, 6) is well developed, and may, in the Artiodactyla, be divided into layers as the *m. nasalis*; in others it may radiate diffusely into the skin.

As a further instance we may take the buccinator of the *Dog* (Pl. 16, fig. 17). The cheek-portion of the muscle is short, the mouth-cleft going far back. The *superficial* layer consists of fibres, which are *att* bent into the upper and the lower lip, the part of the muscle lying in the upper lip being far stronger than that in the lower lip; the posterior bundles are interrupted in the middle by a sort of tendinous raphe. The anterior end of the infralabial part is inserted on the lower jaw. In the *deeper*, longitudinal layer the fibres are all posteriorly longitudinal, but the front end of the dorsal fibres are inflected and inserted into the above mentioned raphe, while the more ventral fibres are going to the angle of the mouth. A *pars supralabialis* is not present. — *Musculus nasalis* and *mentalis* are present.

In *Erinaceus* (Pl. 16, fig. 18) the *superficial* layer of the buccinator behaves in nearly the same manner as in the *Dog*. The *deeper*, longitudinal layer is all longitudinal; the ventral parts thereof are rather strong and extend into the lower lip. The *m. nasalis* (Pl. 11, fig. 3) is split in several layers between which the tendons of the maxillo-labialis are situated. The *m. mentalis* is present.

In *Lemur* the ordinary two layers of the m. buccinatorius are developed. The *transverse* layer is very strong and all its fibres are curved into the lips; a great posterior portion of the fibres of the upper lip have an oblique direction and are inserted into the maxillary bone — as is also the case with part of the transverse layer in *Halmaturus*¹⁾. Posteriorly the m. buccinatorius consists only of the *longitudinal* layer, extending forward inside the transverse layer, which externally is intimately connected with the anterior end of the platysma.

In the *Rabbit* (Pl. 16, fig. 19) there is in the buccinator a *superficial*, principally transverse layer; but the fibres are partly more or less oblique, the most anterior (*a*) having a direction somewhat from above-forward to below-backwards, the next (*b*) having in turn a direction from above-backward to below-forward; the last named crossing and overlaying the former. Inside this transverse layer there is a well-defined *longitudinal* layer extending also into the upper lip. On the side of the maxilla, dorsad to the parts described of the buccinator, is situated a layer of transverse (vertical) fibres (*c*), whose ventral ends are inserted into the buccinator; this muscular plate is evidently a separate part of the buccinator (comp. the buccinator of *Halmaturus*, where also part of the muscle extends upon the upper jaw).

In *Myopotamus* (Pl. 14, fig. 4) the ends of most of the transverse buccinator-fibres are not inserted into the upper and lower jaw respectively but join the corresponding fibres of the other side below the intermaxillary bone, and above the mandible, behind the incisors. On the dorsal side, viz. below the intermaxillary bone, the fibres of the right and the left buccinator pass direct into each other. On the ventral side, above the mandible, the muscular fibres of the right and left buccinator are very near each other, but do not pass direct into one another; the bundles passing into fine tendons, which go from one side to the other, crossing each other. In this manner a powerful sphincter round the front part of the oral cavity is formed. This sphincter is probably developed in many other Rodents and is the active agent in the peculiar shutting of the mouth behind the incisors as is the case in many Rodents.

The general results of the foregoing investigation respecting the buccinator-group in the *Viviparous Mammals* may be summarized as follows (comp. Pl. 17, fig. 3—4):

The buccinator-group consists of three muscles: buccinator, nasalis and mentalis. The *buccinator* forms the bulk of the cheek and extends into the upper and lower lip. The original transverse arrangement of the bundles, still found in *Echidna*, has been modified so that one may generally distinguish *two* distinct — but in some points intimately connected — layers, a superficial transverse and a deeper longitudinal layer; the anterior bundles of the superficial layer are bent so that the ends thereof are directed into the upper and lower lip, running parallel to the margins of the lips, sometimes joining in front the corresponding portion of the opposite side: *pars rimana buccinatorii*²⁾; sometimes also the deeper, longitudinal layer takes part in the formation of this muscular portion. Within the *pars rimana* in the upper lip is often developed a deeper layer of transverse fibres, *pars supralabialis buccinatorii*, generally appearing as a continuation of the longitudinal layer of the cheek. Sometimes the buccinator presents even other complications: a third, and deepest layer may be present; and at the lower margin of the buccinator may be developed a special branch of the muscle extending into the median part of the lower lip. — The *nasalis* and *mentalis* take their origin from the upper and lower jaw respectively, near the teeth, and extend upward-laterad and downward-laterad, ending in the skin, the first being generally divided into several parts separated by the tendons of the maxillo-labialis. We think it probable, that these muscles are derivations of the buccinator.

5. MUSCULUS LATERALIS NASI.

In some of the *Ungulata* (Horse, Ruminants with the exception of the Camels) a muscular fringe consisting of transverse

¹⁾ In the same manner as in the *Prosimiae* also in the *Dog* and *Erinaceus* a smaller posterior portion of the fibres of the upper lip are inserted into the maxillary bone (comp. Pl. 16, fig. 17 and 18; the fibres directed obliquely upward).

²⁾ The »orbicularis oris« autt. is partly this muscle, partly the front portion of the sphincter profundus (comp. p. 7).

fibres is present on the border of the soft nasal wall and the adjoining bones (nasal, intermaxillary, maxillary) and cartilages, the muscular fibres taking their origin from the said bones or cartilages and extending on the soft nasal wall. Sometimes it may be separated in two disconnected portions. This muscle is best developed in the Horse (Pl. 8, fig. 1). Also in the *Dog* (Pl. 12) we have found traces of it at the posterior end of the lateral face of the nasal cartilage. How far it is present in other than the said Mammals and the Elephant (vide infra) we are at a loss to say; we have not found this feeble muscle in others, but must remark that we have not sought much for it, so that it is very possible, that it is more often present than would appear to be the case.

From the m. lateralis nasi probably may be derived some minor muscles in this region, which run from one part of the nasal cartilage to the other or from the cartilage to the soft nasal wall. To these muscles, which we have not had an opportunity of investigating more closely, belongs the *m. transversus nasi* of the Horse, which is more developed than is generally the case with these muscles; some parts of the transversus nasi of the Horse are continued direct into the lateralis.

6. MUSCULI RECTI NASI ET LABIORUM.

In the lips, and also in the soft parts of the nasal tube, there are in many Mammals numerous muscular fibres present, going transversely from the skin to the mucous membrane. The fibres are according to PERREGAUX¹⁾ generally present in the lips and are here termed by AEBY *m. reclus labii*; in the Ungulata which we have examined in this respect they are present. But as already stated similar fibres may also be found in the soft nasal tube, where we have found them in the Camel, Elk, Horse and Tapir and where they have probably a wider distribution. We term the lastnamed fibres *m. rectus nasi*²⁾.

7. MUSCLES OF THE EXTERNAL EAR.

The muscles which are connected with the external ear we shall treat under this head with the exception of the auricular portion of the sphincter profundus, which has already been described. Besides the muscles inserted into the external ear or being situated wholly on it, we also here treat of those, which are inserted into the *scutellum*, a plate of elastic cartilage situated in many Mammals before (and above) the auricle, these muscles naturally, as we shall see, ranking among those of the auricle itself.

A. The ear-muscles in the Placentals with a scutellum.

Of Placentals possessing a scutellum we have particularly examined: Dog, Rabbit, Elk, Cow, Swine, Horse and Tapir.

a. Scutularis-group.

Pl. 15, fig. 4—5.

From the middle line of the head, from the hind parts of the frontal surface unto above the eye, and sometimes from the side of the face behind and below the eye, arises a broad muscular brim, the *m. scutularis*, inserting into the margin of the scutellum, and being divided into several more or less separated subdivisions. Often the muscle instead of taking origin from the middle line is here continued into the corresponding muscle of the opposite side, thus forming a transverse muscular band across the head (Dog, Pl. 15, fig. 5, Rabbit, Elk). From the M. scutularis branches off a bundle, *pars transiens*³⁾, which is not inserted into the scutellum, but crossing it, is inserted into the auricle itself (on the convex side near the anterior margin, or into this last); some of the fibres of the *pars transiens* may arise from the scutellum.

¹⁾ Einiges über die Lippenmuskulatur d. Säugetiere. Inaug. Diss. Bern. 1884.

²⁾ The above-mentioned *mm. nasalis* and *mentalis* often join so closely with *recti*-bundles, having also a similar direction, that we may not suppress the remark, that it is not precluded, that these muscles, which we have ranked above with the buccinator, are in reality *recti*-bundles, which have at one end been attached to the bone.

³⁾ »Oberer Einwärtszieher«, *adductor superior*, of the Veterinarians.

As to details of the *m. scutularis* we note the following. In the *Dog* (Pl. 15, fig. 5) — where the muscle is strongly developed and extends far forward on the front — as well as in the *Rabbit* and the *Elk* the hindmost dorsal part of the *m. scutularis* joins the corresponding one of the other side across the head and forms a great muscular plate going from one scutellum to the other. In *Swine* an aponeurosis unites the dorsal ends of the scutularis-fibres of the right and left side. In the *Dog* the foremost ventral part, *pars antero-ventralis* nob. (Pl. 12; Pl. 15, fig. 5), of the scutularis has a certain similarity to the *pars zygomatica platysmatis* of many Mammals and has indeed received the name: *m. zygomaticus*; it is a narrow oblique ribbon extending from the scutellum into the upper lip; in the other forms with a scutellum examined by us this part of the muscle is not developed in this manner, and the whole ventral part does not extend far down on the face. The scutularis of the *Tapir* (Pl. 7) is peculiar in that a small anterior portion, taking its origin from the skull above the eye, is connected through a rather long tendinous band with the rest of the muscle, which otherwise does not extend so far in front.

As mentioned above the *pars transiens muscoli scutularis* is composed of fibres of the scutularis crossing the scutellum and of others arising from it. If we imagine, that the crossing fibres of the *pars transiens* disappear, those of its fibres, which take their origin from the surface of the scutellum would alone be left, and the *pars transiens* would then appear as a separate muscle arising from the scutellum. In *Swine*, at least in the specimen figured (Pl. 9), this emancipation has for the most part taken place, the dorsal bundles of the *pars transiens* being all quite separate.

We make this remark because there arises from the scutellum two muscles, which we think may possibly have been developed from the scutularis in this manner and which therefore we rank with the scutularis-complex. One of these is the *m. levator brevis* («kurzer Heber») of the Veterinarians (Pl. 15, fig. 4), which arises from the outer surface of the scutellum and is inserted into the convex surface of the ear (Horse, Tapir, Elk, Cow; in the other forms examined we have not found this muscle). As to the derivation of this muscle from the scutularis comp. the description of the scutularis of *Didelphys* given below. The other muscle, which we are inclined to derive from the scutularis, is the *m. rotator* (Pl. 15, fig. 5), a strong muscle arising from the inner surface of the scutellum; its fibres are directed backward (and downward) and inserted into the proximal part of the mediad side of the auricle; in the Horse and Tapir it consists of two distinct crossing portions¹⁾.

b. Auriculo-occipitalis-group.

Pl. 15, fig. 4—6.

The *m. auriculo-occipitalis* is a lamelliform muscle taking its origin on the occiput and the neck from a tendinous median dorsal line, where it meets the corresponding muscle of the other side; it extends over the pinna, into whose mediad side it is inserted; in addition it is inserted into the scutellum, and the foremost part of it frequently extends as a muscular plate on the dorsal side of the head. It has its place behind the scutularis; as far as it extends into the same region as this, it is covered by the scutularis. The direction of the fibres of the auriculo-occipitalis is posteriorly chiefly transverse, anteriorly longitudinal. The anterior part, consisting of longitudinal fibres and extending on the dorsal side of the cranium, we term the *epicranial part*; the next part, inserted into the scutellum, we term the *scutellular part*, the last part, inserted into the auricle, the *auricular part*. They may be confluent or more or less separated. The epicranial part may be wanting.

In the *Dog* (Pl. 15, fig. 5) the muscle is fully developed: it extends on the auricle, is further inserted into the scutellum and extends forwards on the dorsal side of the head (the lastnamed part

¹⁾ In the *Cow*, where the muscle has a more dorso-ventrad direction than usual, a rather large foremost part of it inserts partially into the deeper portion of the *m. postauricularis*, partially into a prominence of the skull above the bony meatus.

of the muscle is the *m. epicranius s. occipitalis* of Ellenberger-Baum, Anatomie des Hundes). In a similar manner the muscle is developed in the *Rabbit*, the *Lama* and the *Elk*: the muscle is inserted into the auricle (in the *Elk* through a separate slip) and further into the scutellum, and it is continued on the upper side of the head. In the *Swine* examined the muscle is rather small; it is deeply split up into five slips, of which the four first have all the same direction: obliquely-forward; the hindmost of these four inserts partially into the scutellum, the rest is epicranial. The fifth slip inserts into the ear. In the *Tapir* (Pl. 7) the muscle is separated into three portions, the hindmost inserting into the auricle; the two anterior extend both beneath the scutularis, none of them reaching the scutellum. In the *Horse* the epicranial part has disappeared, but the auricular and scutellular are both well developed and only partially separated; the scutellular part, which is a broad plate largely tendinous, is generally described as a deep layer of the *m. scutularis*. In the *Cow* the epicranial part has also disappeared and the auricular and scutellular parts are intimately connected.

Inside the auriculo-occipitalis, from the same tendinous line on the occiput and the neck, the *musculus postauricularis* (= *m. auricularis posterior* of Ruge) takes its origin (Pl. 15, fig. 5). It consists firstly (1) of a *superficial part*, which is inserted into a line on the caudad side of the auricle; it is in the *Swine* a broad fan-shaped continuous muscular plate, but generally is split up into two (Horse, Tapir, Cow, Rabbit) or three (Elk, Dog) digitiform portions (Pl. 15, fig. 6), which at their origin generally cohere, but more or less widely separated run to the auricle; of the three digitations in the *Dog* the foremost is inserted into the scutellum, but in the *Elk* all are inserted into the auricle (from the foremost digitation in the *Elk* some fibres insert also into the scutellum¹⁾). Secondly (2) there is a *deeper part*, which arises posteriorly either separately from the above-named tendinous line (*Dog*, Pl. 15, fig. 5; *Rabbit*) or from the inner side of the superficial part (*Ungulata* generally) or from both²⁾ (*Elk*, Pl. 15, fig. 6); it inserts below the insertion of the *m. rotator* hard above the incisura³⁾ 2 + 3. — As to the original connection of the postauricularis and the auriculo-occipitalis comp. the statements below on the Marsupials.

To the auriculo-occipitalis-group further belong the muscles which in the veterinary anatomical treatises are termed: *mm. adductor medius* and *inferior*.

The *m. adductor medius* is, in the *Swine* (Pl. 9), quite a separate muscle taking its origin from the inferior margin of the scutellum and inserting into the anterior side of the auricle covered by the *pars transiens muscoli scutularis*. Also in the *Tapir* it is quite a separate muscle. But generally in the animals examined it appears partially as a *continuation of the auriculo-occipitalis*, some of the fibres taking their origin from the scutellum but others being a continuation of fibres of the auriculo-occipitalis. Such is the case in the *Rabbit*, the *Horse*, the *Cow* and the *Elk*. In the *Dog* (Pl. 15, fig. 5) the foremost slip of the *m. postauricularis* is inside the scutellum confluent with the auriculo-occipitalis and from this muscle part of the fibres of the adductor medius arise, while others arise from the scutellum⁴⁾.

While, from a comparison of the animals in question we might contend that the adductor medius is a portion of the auriculo-occipitalis, this is not possible with regard to the *adductor inferior*, which is in all these forms quite a separate muscle; it is only by taking the Marsupials into comparison that it may be demonstrated, that this muscle also is part of the auriculo-occipitalis (comp. below p. 21).

The *m. adductor inferior* (Pl. 15, fig. 4) is a fan-shaped flat muscle, which takes its origin from the lower margin of the scutellum and from the face below it (sometimes from the zygoma) and inserts round the incisura posterior 4 near the insertion of

¹⁾ The foremost of the two muscular slips in the *Horse* has a more caudad direction than general and inserts into the auricle with a narrow tendon, not broadly as usual; it gives rather the impression of a separate muscle («mittlerer Heber», *levator medius*, of the Veterinarians).

²⁾ Also in the *Dog* there is a connection between the superficial and the deep part of the *m. postauricularis* (Pl. 15, fig. 5).

³⁾ Comp. as to «incisura», «anteron» and «posterion», Boas, Z. vergl. Anat. d. Ohrknorpels der Säugetiere, in: Anat. Anzeiger 30, Bd., 1907, p. 434—42.

⁴⁾ In the *Dog* there is a separate muscular slip, which inserts into the anterion 5 at the inner angle of incisura 4, and which sometimes appears as a direct continuation of the postauricularis; this little slip is not present in the other animals examined.

the auricular portion of the sphincter profundus; the fibres have a predominant longitudinal direction. Sometimes it arises almost only from the scutellum (Elk), in others it arises only from the face farther down (Dog, Pl. 12; Cow); in the Horse it has been divided into two quite separate muscles («adductor inferior» and «adductor externus» of the Veterinarians), of which only the upper takes its origin from the scutellum. In the *Swine* (Pl. 9) the muscle is divided into three small portions, which together form a three-lobed fan, and of which only the uppermost takes its origin from the scutellum; the front ends of the others are connected with the ends of the fibres of some of the scutularis-bundles, of which a large part do not reach the scutellum in the *Swine*. This is a secondary connection (comp. the Marsupials).

c. Musculus temporo-auricularis.

The *m. temporo-auricularis*¹⁾ (Pl. 15, fig. 5) is a narrow, often rather long muscle, which has its place along the cartilaginous meatus and inserts into the anteron 5, below the rotator. It takes its origin sometimes from the lower jaw (Dog, Rabbit), sometimes from the bony meatus (Horse), sometimes from the posterior end of the zygoma (Elk, Swine). The muscle is quite independent and presents no connection with other muscles; it might be thought probable that it is to be derived from one of the two great muscular complexes described above, but there is no indication of the way in which it may have arisen from any of them.

d. Muscles which both arise from and insert into the auricular cartilage.

The *m. anteri sexti* — = *m. helicis major* + *minor hom.* — (Pl. 15, fig. 4; Pl. 12) is a small muscle lying near the anterior border of the ear before the anteron 6; sometimes it arises from the anteron 5 and inserts into the anteron 7 (Dog, Swine); in others it takes its origin from the posteron 4 or tragus (Horse, Elk).

Dog. Lies on the concave side of the auricle, near the anterior border in the furrow before the anteron 6, taking its origin from the proximal part of the anteron 5 and inserting into the proximal margin of the anteron 7.

Rabbit. Lies along the very elongated anteron 6 on the corresponding place as in the Dog. It is a long thin muscle.

Swine. Arises from the anteron 5 and inserts into the anteron 7, lying near the anterior margin — as in the Dog. But in the *Swine*, where the muscle is rather strong, there is furthermore a portion developed, intimately connected with the first described, taking its origin from the margin of the incisura anterior 4.

Horse. Takes its origin from the posteron 4 (tragus) and lies in the furrow outside the anteron 6, into which furrow it is also inserted.

Elk. A rather broad muscle lying on the concave side of the auricle proximad of the anteron 6 and taking its origin as in the Horse from the posteron 4.

M. posteri septimi — = *m. antitragicus hom.* — (Pl. 15, fig. 4; Pl. 9). Of the animals examined by us we have only found this muscle in the *Dog*, *Rabbit* and *Swine* (Pl. 9). In all these the muscle inserts into the proximal margin of the posteron 7, which in these animals is well developed; sometimes the insertion extends somewhat on the external (Dog) or internal (Swine) face of the posteron. As to the *origin* of the muscle, this is variable. In the *Swine* it arises from the margin of the antitragus and from the distal margin of the posteron 5. In the *Dog* it arises from the proximal margin of the posteron 5 and from the convex surface of the concha, but not from the antitragus. In the *Rabbit* it arises only from the convex surface of the concha. (In *man* it arises from the antitragus and goes to the posteron 7)²⁾.

M. fissuratis (Pl. 15, fig. 4) takes its origin from the posteron 4 (tragus) and inserts into the anteron 5.

Dog. Takes its origin from the inflected margin of the tragus and inserts into the concave surface of the anteron 5.

¹⁾ Of the Veterinarians falsely named *m. tragicus* and homologized with the muscle of this name of man, which is quite another.

²⁾ Quain, Anatomy, Vol. 3, Part 3, 10. Ed. p. 75.

Rabbit. Covered by the *m. trago-antenus* and the adductor inferior. It is a rather strong muscle, taking its origin from the proximal part of the tragus and inserting into the proximal part of the anteron 5. The proximal part of the muscle, which at the insertion is confluent with the rest, is a long slender muscle taking its origin from the bony meatus.

Horse. A short rather strong muscle going between the tragus and the anteron 5, which overlaps the tragus.

Elk and Swine (Pl. 9). Arises from the surface of the tragus and inserts into the margin of the anteron 5.

We think this muscle is the true homologue of the *m. tragicus* of man. This muscle has its place on the tragus and *sometimes*¹⁾ it sends some bundles to the «spina helicis», the homologue of the anteron 5.

The *m. trago-antenus* we have only found in the *Dog* (Pl. 9) and *Rabbit*. In the *Dog* it arises with three slips: one takes its origin from the outside, near the proximal border, of the tragus; another from the outside of the posteron 3, the third from the ear-cartilage between the posteron 2 and the anteron 2; all insert into the anterior margin of the anteron 5. In the *Rabbit* it is a very broad, short muscular band going from the very elongated lateral margin of the tragus to that part of the anterior margin of the ear which in the Rabbit represents the margin of the anteron 5.

In the *Rabbit* alone we have found a muscle, which covers the fissure between the antitragus and the posteron 5, a layer of transverse-oblique muscular fibres going from the antitragus to the posteron 5. We propose for this muscle the name: *m. antitrago-posterus*.

Besides these muscles there may, on the convex surface of the auricle, be present tracts of muscular fibres. They are called *m. transversi* and *obliqui* and the direction of the generally short fibres may be either longitudinal or transverse. In the Dog the above-described *m. posteri septimi* is continued by such a muscular tract across the auricle.

B. The ear-muscles of the Marsupials.²⁾

The facts surveyed in the preceding part, with regard to the ear-muscles of the Placentals, are better understood if the ear-muscles of the Marsupials are also taken into consideration.

In *Didelphys* (Pl. 15, fig. 3; fig. A) there are *two* large lamelliform ear-muscles lying on the head above and in front of the ear, from the eye to the neck; the two muscle-plates overlap one another a little, the anterior being external. The anterior muscle, the *scutularis*, sends off a *pars transiens*, which segregating from the rest of the muscle is inserted into the anteron 7; it entirely resembles the muscular portion of the same name in the Placentals. The rest of the muscle is continued into a rather narrow but thick muscular body, lying directly above the ear-conch, which gradually grows narrower and is inserted into the arched surface of the ear-conch (Pl. 15, fig. 3, *scutularis, a*). This part of the muscle is intimately connate with the other great muscle-plate, which it overlies. We think this narrow terminal part of the *scutularis* corresponds to the *tevector brevis* of the Horse and other animals; like it, it is inserted into the auricle near the insertion of the auriculo-occipitalis, which in *Didelphys* here overlies it. This is not the case in the Horse and Elk, the auriculo-occipitalis not extending so far on the auricle as in *Didelphys*.

The other large, lamelliform, muscle of *Didelphys* corresponds to the *auriculo-occipitalis* + the *postauricularis* of the Placentals; which two muscles are still continuous in *Didelphys*; moreover, posteriorly, this great muscular plate is continued in such a manner into the *ptalysma* behind the ear that it has quite the appearance of a forward continuation of the last-named muscle, the fibres of which here have the same direction as the neighbouring fibres of the auriculo-occipitalis + postauricularis; dorsally a natural limit does not exist. The muscular plate may be divided into three portions, which dorsally are continuous, but ventrally are more or less separated through splits having a dorso-ventrad

¹⁾ Henle, Eingeweidelehre, 2. Aufl. p. 757.

²⁾ In this group a scutellum is not developed.

direction; the foremost portion is the largest, the hindmost the smallest. We term them *pars anterior*, *intermedia* and *posterior*. The *pars anterior* and *intermedia* represent together the m. auriculo-occipitalis of the Placentals. The *pars anterior* is fanshaped, the muscle taking its origin from the posterior end of the sagittal crest, from which point the fibres diverge, those near the median line having a longitudinal direction, while those of the lateral parts have a direction somewhat transverse. In front of the opening of the ear-conch (fig. A) is situated a narrow muscular slip, which is inserted into the posteron 4 near the insertion of the auricular portion of the sphincter profundus; it evidently corresponds to the *adductor inferior* of the Placentals. If we follow the fibres of this muscular slip from their insertion we find them going dorsad, below the terminal part of the scutularis, and being continued into some of the above-named lateral fibres of the anterior part of the *musc. auriculo-occipitalis*, while others are inserted direct on the auricle (anterior 5). Where the fibres of the two muscles, the scutularis and the auriculo-occipitalis, cross one another, they are intimately connected. It is evidently in this place that the scutellum has been developed in the Placentals; and as a consequence of the development of the scutellum parts of the two great muscles have been cut off respectively to form the *levator brevis* (from the scutularis) and the *adductor inferior* (from the auriculo-occipitalis). — The *pars intermedia* is inserted into the convex surface of the auricle much as the posterior part of the auriculo-occipitalis is inserted in the Placentals. — The *pars posterior* of the muscle inserts into the auricle in the same place as the *deep portion* of the *postauricularis* of the Placentals and evidently corresponds to this. In what manner the *superficial* portion of the *postauricularis* in the Placentals has taken its origin we cannot say with certainty. In *Didelphys* there is no trace of it. Possibly it has arisen from the *pars intermedia* of the auriculo-occipitalis + *postauricularis* of *Didelphys*, this portion having been split up into two layers, of which the deeper has been developed into the superficial portion of the *postauricularis*.

In *Halmaturus* the m. scutularis and the auriculo-occipitalis + *postauricularis* behave in the main in the same way as in *Didelphys*, but the anterior part of the auriculo-occipitalis + *postauricularis* has a somewhat more complicated structure.

The m. *temporo-auricularis* is in *Didelphys* quite similar to that of the Placentals and gives no key to the understanding of this muscle. It takes its origin from the mandible, and is inserted into the anterior 5 and the neighbouring parts of the auricle, below the insertion of the scutularis. — In *Halmaturus* (Pl. 13, fig. 3) this muscle differs in taking its origin from the hind part of the zygoma (comp. the Placentals).

The muscles, which both arise from, and are inserted into, the auricular cartilage, we have only studied in *Halmaturus*; which possesses the same muscles as the Dog. They present no marked features of interest.

The m. *anterior sexti* (Pl. 13, fig. 2; comp. fig. 3) has its place before the anterior 6, bridging the incisure which separates a proximal spiniform part from the rest of the anterior.

The m. *posterior septimi* (Pl. 13, fig. 1—2; comp. fig. 3) is a flat muscular band going from the proximal margin of the posteron 7 to the posteron 5 bridging the broad incisure between them.

The m. *fissuratis* takes its origin from the concave (hinder) side of the anterior 5, and is inserted into the end of the posteron 4.

The m. *trago-anterus* arises from the proximal corner of the anterior 5 and is inserted into the posteron 4 outside the m. *fissuratis*.

C. The ear-muscles in Placentals without a scutellum.

Among the Placentals, in which no scutellum is developed, we have studied the ear-muscles of *Centetes* (fig. B, C). We only describe the muscles going from the head to the auricle.

Of greater ear-muscles *Centetes* possesses the same as other Placentals, viz. *scutularis*, *auriculo-occipitalis* and *postauricularis*. Besides these there is an *adductor inferior* and a *temporo-auricularis*.

The *scutularis* (fig. C) is divided into three portions, which appear as separate muscles, 1) an *antero-superior*, 2) an *antero-inferior* and 3) a *posterior* portion. The *first* (a) arises on the upper side of the skull in front of the eye, close to that of the opposite side; only the inferior fibres thereof reach the ear (anterior 5), the superior ending free, intermingling with those of the other portions. The *second* portion (c) takes its origin from the angle of the mouth (comp. the *pars antero-ventralis* of the Dog, p. 17) and goes to the ear, where some bundles of it insert into the anterior 5, while the rest extend above the ear, the fibres intermingling with those of the first and the *third* portion (b) which latter has a transverse direction and, in the middle line, joins the corresponding muscle of the other side, thus forming a broad muscular band going across the skull from one ear to the other; only the posterior bundles, corresponding to the *pars transiens*, reach the auricle, the rest intermingle with the fibres of the two other portions.

Close in front of the antero-inferior portion (c) is situated a muscle (d) taking its origin from the small zygoma below the eye, and ending, halfway between the eye and the ear. We suppose that this muscle is a detached part of the antero-inferior portion of the scutularis.

The *auriculo-occipitalis* (fig. C) is a large, thin, muscular plate which takes its origin from a long tendinous stripe on the occiput and the neck and only at its antero-external angle is inserted into the auricle, while for the rest, it covers the dorsal side of the head between the auricles, and further forward.

The *postauricularis* (fig. C) consists of a superficial part composed of two deeply separated slips, and of a deep portion, represented by a long slender muscular ribbon.

The *adductor inferior* (fig. B) arises on the face, in front of the ear, and extends backward inserting into the base of the tragus.

The *temporo-auricularis* takes its origin from the mandible and is inserted into the anterior 5.

Of the ear-muscles of *Centetes* the *scutularis* is of special interest. We suppose, that *Centetes* is to be derived from a Mammal which possessed a scutellum, in other words, that the absence of this has not as in the Marsupials a primitive character. The several portions into which the scutularis is separated we think is an indication of the original presence of a scutellum, lying in the place where the greater part of the fibres of the three portions meet one another. The connection of the scutularis with the auricle we regard as secondary (that of the *pars transiens* naturally excepted).

In a similar manner we think that the ear-muscles of other Placentals lacking a scutellum should be interpreted. But we have not been able to spare time for making further investigations.

D. The ear-muscles of the Monotremata.

We regret to say, that the Monotremata, of which we have examined *Echidna* (Pl. 10), do not afford decisive contributions to the understanding of the ear-muscles.

The rather large ear-cartilage of *Echidna* is almost wholly imbedded in the large muscular mass of the *platysma*. An insertion into the auricle takes place only to a very limited extent. On the mediad side there is inserted a well-defined bundle of the *platysma*. This having a dorso-ventrad direction, perhaps, is the homologue of the terminal slip of the scutularis in *Didelphys*. Another slip, having a direction from behind forward, is inserted into the hinder side of the tragus, into which is also inserted a small portion of *platysma* taking its origin from the anterior margin and the adjoining part of the concave side of the auricle (b, Pl. 10, fig. 1); and of the *platysma*-bundles which go to the angle of the mouth the deeper ones take their origin from the tragus; whereas the superficial ones come from the bulk of

the platysma lying behind the ear. Further we note, that some of the platysma-bundles going forward below the eye take their origin from the mediad side of the ear near the hind margin.

Already the facts found in the Marsupials suggest that the muscles of the outer ear may be derived from the *platysma*. What we have seen in *Echidna* strongly supports this suggestion. As far as the greater muscular complexes of the ear, the scutularis-group and the auriculo-occipitalis-group, are concerned, it may, from the facts adduced, be taken as granted that they are originally parts of the platysma. Unfortunately the conditions found in *Echidna* are so far remote from those of other Mammals that the course of development which has taken place cannot be demonstrated in detail at present.

8. CONCLUDING REMARKS.

As is well-known GEGENBAUR and RUGE have very positively advanced the view, that the totality of the facial muscles of the Mammals should be ultimately derived from one primary muscle, viz. the *sphincter colli* of the Amphibians and Reptilians, which should have extended over the head and split up into numerous muscles. This idea was pronounced for the first time some twenty years ago by GEGENBAUR, and later on further worked out by RUGE in his excellent treatise of the facial muscles of the Prosimiæ, and in other papers.

This theory decidedly is not a little engaging; and it is also beyond dispute that to a large extent differentiations have taken place, so that in many cases *one* muscle has been split up into

a number of muscles. But the facts at hand do not prove the inference that this differentiation was of such a nature, that finally the whole of the facial muscles were derived from the single muscle of the Amphibians and Reptilians. That these muscles all are supplied with branches from the *nervus facialis*, cannot settle the question; the n. facialis supplies, besides the facial muscles, the mm. stapedius, stylo-hyoideus and digastricus, which have nothing to do with the facial muscles. It appears then quite possible, that among the muscles termed facial muscles, there may be some, which have also an origin independent of the rest. On the whole, one nerve may, in many cases, supply organs which have nothing in common.

Neither does the *comparison* furnish us with conclusive facts. It is true, that in the lowest Mammals, the Monotremata, the facial muscles are continuous to an extent that we do not find in any other Mammals; but in no way can what is found in the Monotremes be regarded as demonstrating the above-mentioned theory: the system of facial muscles of the Monotremes is already richly differentiated, and widely different from the supposed simple starting point. Still less do the facial muscles in other Mammals present conditions which could be regarded as supporting the idea of such an origin. And it does not suffice to say, that the development of the system of facial muscles is only conceivable in this manner; at all events it were not beyond the possibilities that various facial muscles had taken origin independently of one another from indifferent mesoblastic elements in connection with the development of the eye-lids, the lips, the external ear etc.

Thus we must agree, that the question of the origin of the facial muscles of Mammals is still an open one.

B.

THE FACIAL MUSCLES

OF

THE ELEPHANT.¹⁾

1. SPHINCTER-PLATYSMA-GROUP.

Pl. 1.

In the material at our disposal, of this group of muscles only the *platysma* and the auricular portion of the *sphincter profundus* are present. Postponing the description of the latter muscle to the auricular muscles, we shall in this place only treat of the *platysma*.

From the median dorsal line of the occiput and the neck there arises an aponeurosis; at its origin, thick, strong and containing some elastic tissue. It extends down the side of the neck where it gradually grows thinner and more fibrous, covers the surface of the parotis and then turns on to the face, on the outside of m. masseter (in Pl. 1 somewhat of the aponeurosis has been removed).

The fleshy part of *platysma* arises from this aponeurosis; it extends upon the face and is divided into two rather well marked portions, a *mandibular portion* and an *angular portion*.

The *mandibular portion* arises nearly in the middle of the lateral face of the neck and forms a narrow ribbon-shaped muscle

which turns on to the lower part of the face, covering the lower part of m. masseter; its upper margin is continued in the part of the aponeurosis which covers the rest of the masseter (omitted in Pl. 1). On the *left* side of the head the muscle is inserted outside the lower jaw, in front of the masseter. On the *right* side it divides into 3 branches, of which the inferior (Pl. 1, *a*), rather a broad one, is inserted outside the lower jaw, in front of masseter; the second (Pl. 1, *b*), somewhat narrower branch turns a little upwards, thrusts itself under the lower part of m. buccinatorius, and is inserted into the lower jaw just below this muscle; the uppermost branch (Pl. 1, *c*) bends very much upwards and forwards and joins the angular portion.

The *angular portion* arises from the aponeurosis on the outside of the masseter. Behind the origin of the angular portion, and above the mandibular portion, a rather considerable part of the masseter thus remains free, covered only by the aponeurosis. On the *left* side the angular portion forms a closely connected muscle, which arises with 4 or 5 flat, broad portions; they join a little behind the angle of the mouth, the bundles running under each other and projecting into the m. buccinatorius. The

¹⁾ In dissecting the facial muscles of the Elephant we have made some observations relating to the *skin* and the *hairs* of the head, which may be recorded here.

The *corium* is of very different thickness on different parts of the head. It is thickest postero-dorsally, between the ears; in the median line the corium is here 2 cm thick and very dense. Forward it gradually diminishes in thickness, but still, in the median line between the eyes, the corium is 1 cm thick. The same thickness is preserved as far as the base of the trunk, but then rapidly diminishes distad over the trunk, so that the skin is soon only a couple of mm thick, and towards the tip of the trunk it is scarcely one mm thick. Laterally and ventrally on the head the thickness of the skin is, on the whole, somewhat less than dorsally; in some places, for instance round the eye, the skin is much thinner than in the surrounding parts. In most places the corium appears as a stratum, which may be dissected off, and such is also the case on the trunk unto very near the distal end; only in a few places, viz. in the tip of the trunk, in the inferior lip and in the upper lip (from the angle of the mouth to a point a little in front of the incisor) the corium forms a continuum with the underlying muscular fascicles and connective tissue.

As to the *outer surface* of the skin it is everywhere covered with small warts. On those parts, where the skin is thick, these warts are each furnished with a thick horny layer (resembling a short obtuse spine), and groups of these warts are here united into larger warts of different sizes, separated from the neighbouring prominences by deep furrows.

The skin is furnished all over with *hairs*, which vary greatly in abundance. The hairs for the most part project nearly at right angles to the surface. They are mostly rather thick and rigid; their thickness is very variable. On the dorsal part

of the head they are thickest, on the under side of the trunk remarkably fine. They may be rather long (5—7 cm), especially on the upper side of the head, round the opening of the ear and on the upper and lower lip, but most of the hairs are short stubbles.

The hairs are found more closely arranged dorsally from behind to the root of the trunk, but of a continuous hairy coat there is also here no question, there being rather considerable distances (2—5 mm) between the individual hairs. On the lateral aspect of the head (the cheek) they are more scattered, but become more numerous along the margin of the lower jaw, and forward on the lower lip. On the eyelids, especially the upper eyelid, there are some few hairs. Along the margin of the upper eyelid the eyelashes are developed, which are numerous, long, and stiff; and arranged in several series; along the lower eyelid they are shorter and much less numerous. On the external ear there are hairs scattered along the whole margin and single hairs on both surfaces; on the medial surface they are very fine. Round the entrance into the meatus the hairs are more dense.

Along the margin of the upper lip there are rather numerous hairs, of which some look almost as though they were *vibrissae*; but they have no sinus round them. On the lower lip there are some scattered long, thick and stiff hairs, which are real *sinus-hairs*. Along the whole length of the trunk there are short, thin, scattered hairs, most numerous on the dorsal and lateral sides. From about the middle of the trunk to the distal end there appear between these, especially laterally, some long and stiff hairs, which are surrounded with a well-developed sinus. The digitiform prominence at the tip of the trunk is almost hairless, but the ventral margin of the nasal opening is studded with scattered quite short stiff hairs, round which we have found a small sinus.

whole muscle thereby becomes fanshaped: narrow, but thick and rather strong at the insertion — flat, broad and separated in several portions at the origin. The whole line of origin, which forms a bow, convex posteriorly, nearly reaches the middle of the masseter; and the upper portion is some distance from the zygoma. Dorsad the muscle is continued into a thin aponeurosis, which vanishes over the zygoma. — On the *right* side of the head (Pl. 1) the angular portion consists of two well marked branches (*d* and *e*), to which furthermore joins the uppermost branch (*c*) of the mandibular portion; all three branches converge a little behind the angle of the mouth, where they project into the *m. buccinatorius*, the branches *d* and *e* here join closely. The branch *d* arises on the middle of the masseter from the aponeurosis. The uppermost branch (Pl. 1, *e*), however, turns its hindmost end backwards and upwards and in the aponeurosis there is a thickened portion (Pl. 1, *f*) which is inserted on the lower edge of the zygoma, and which may easily be dissected out as a separate tendon of the uppermost branch; or, in other words, on this side of the head there is formed a strongly marked *pars zygomatica platysmatis*, which, however, shows its close connection with — or we might say — its origin from the platysma by the very intimate cohesion with the rest of the angular portion. In comparison with this the left side shows a more primitive state, as a distinct (separate) portion of the platysma, which may be designated as a »*pars zygomatica*«, has not yet been singled out here.

As mentioned above, the fascicles of the angular portion join and project into the buccinator a little behind the angle of the mouth. The buccinator and the platysma are here quite interlaced; the bundles of the platysma, in several rows (v. Pl. 4), one behind the other, projecting between the bundles of the buccinator; farther on they join the longitudinal bundles of this muscle.

Upon the whole the relation of the *pars zygomatica* to the rest of the platysma in the Elephant examined appears with the stamp of a more primitive state than that found in the Ungulates (vide General Part p. 9). Only in Alces is there still found some connection between them, but not by any means to such an extent as in the Elephant.

In some respects the platysma of the Elephant resembles that of the Ungulates. We find in both of them the great reduction of the cervical portion which is wholly transformed into an aponeurosis. But in the Elephant the muscular part of the platysma is also somewhat reduced, since it corresponds only to the *lower* part of the *pars principalis* (+ *pars zygomatica*) in the Ungulates; thus it most resembles that of the Camel (Pl. 5). In all the other Ungulates examined there is besides an upper part of the *pars principalis* which, now as a continuous muscular plate (Wapiti, Boar, Tapir), now as more or less separated bundles (Bos, Horse, Elk), crosses the masseter; all this upper part of the *pars principalis* is wanting in the Elephant. The part of the platysma which remains shows several peculiarities, has undergone considerable modifications which no doubt are rather closely connected with the transformation that the whole face of this animal has undergone. The continuous lower part of the *pars principalis* of the Ungulates has, in the Elephant, been split into two well marked portions, an angular portion and a mandibular portion, and the origin of the angular portion has been raised considerably on the outside of the masseter. Last but not least, the direction of the fibres must be observed. In the Ungulates they are longitudinal, in the Elephant, however, they ascend in an arc and converge towards the angle of the mouth. These alterations of the platysma, no doubt, stand in close connection with the abbreviation of the face, by which the angle of the mouth has been drawn so far back (almost under the eye), partly they are evidently due to the fact that the angle of the mouth has been raised so much in the Elephant.

The accounts of the platysma in WATSON¹⁾ (»*panniculus car-*

nosus«) and MIALl and GREENWOOD²⁾ (»*platysma myoides*, facial portion of *panniculus*«) are very short and incomplete. They mention the insertion of the bundles of the platysma partly into the lower jaw partly at the angle of the mouth; but also state that the upper bundles insert themselves into »the facial aponeurosis below the zygoma«²⁾. We have not found this. — The *pars zygomatica platysmatis*, which in both papers is described by the name of »*zygomatiko-labialis*«, was evidently present in a fully developed form in the specimen examined by MIALl and GREENWOOD. But in the paper of WATSON the description is rather vague. One has the impression that his specimen presented the same conditions as the left side of our specimen, viz. that in reality there was no distinctly separated *pars zygomatica*.

2. ORBICULARIS-OCULI-GROUP.

Pl. 1; Pl. 4; Pl. 16, fig. 20.

The *m. orbicularis oculi* (Pl. 1 and Pl. 16, fig. 20) is a strong, rather thick muscle of about the same width in the upper eyelid as in the lower; but in neither of them so wide that it goes beyond the bony aperture of the orbit. It is a very coarse-fibred muscle, the fascicles of which may, without difficulty, be dissected throughout their whole length. The muscle does not form a complete ring. At the anterior angle there is a broad, thick ligamentum palpebrale (anterior, nasale), from the upper and lower margin of which the fibres arise. From the upper margin the fibres ascend in an arc into the upper lid; the fibres that are most superficial at the origin only reach a short distance into the eyelid and insert themselves into the skin with pointed, short tendons. The other fibres gradually grow longer and the longest penetrate the whole of the upper eyelid unto behind the posterior angle, from which some of them descend a little into the lower eyelid. In the lower eyelid the fibres behave in a corresponding manner. At the posterior angle the fibres meet and their free ends are intimately interlaced. This interlacement is further complicated by the *m. postorbicularis*, which begins with rather short bundles that go round the posterior angle, and are bent in a manner quite similar to the bundles of the *m. orbicularis* with which they are interlaced. Caudad the fascicles of the *m. postorbicularis* grow gradually straight, so that they at last go almost dorso-ventrad. The whole *m. postorbicularis* forms a rather broad muscular plate behind the *m. orbicularis* consisting of thick, coarse fascicles which »anastomose«: a small branch parting from one fascicle and then passing obliquely downwards to join a neighbouring fascicle. In Pl. 16, fig. 20 only a single »anastomosing« fascicle is seen whereas the other rather numerous »anastomoses« only become visible by spreading the bundles; especially between the posterior fascicles of the *m. postorbicularis* these »anastomoses« were so numerous that one might fairly speak of a reticular arrangement of the fascicles.

In front of the *m. orbicularis*, covered in its middle by the lig. palpebrale nasale, the *m. præorbicularis* (Pl. 4) is seen, having the form of two fan-shaped, dorsad and ventrad radiating portions (the *m. præorbicularis dorsalis et ventralis*). By loosening the ligamentum it becomes plain that the posterior fascicles are traversing ones, extending from above downwards in an arc inside the ligamentum, and closely joining the orbicularis-fascicles. The anterior fascicles, however, are interrupted; they arise separately inside the lig. palpebrale. The dorsal ones cover most of the origin of the *m. nasolabialis*, whereas the ventral ones partly interlace between the fascicles of the latter (Pl. 4).

The *m. nasolabialis* (Pl. 1 and 4) is in front of the *m. præorbicularis*. It intimately joins the *m. præorbicularis* but still it may be distinctly separated from it by dissection. It is a small muscle composed of coarse fascicles with plenty of intramuscular adipose connective tissue. It arises above and a little in front of the orbit, partly from the frontal bone, partly from the fascia that covers the portio superior *m. maxillo-labialis*. The origin is mostly covered by the *m. præorbicularis dorsalis*. The fascicles go downwards in the shape of a fan; the posterior ones go almost straight downwards in the direction of the angle of the mouth,

¹⁾ Contributions to the Anatomy of the Indian Elephant. Part IV. Muscles and Blood-vessels of the face and head. in: Journ. of Anat. and Physiol. Vol. 9. 1874.

²⁾ Studies in Comparative Anatomy. II. Anatomy of the Indian Elephant. London 1878. Reprinted from Journ. of Anat. and Physiol. Vol. 12—13.

³⁾ MIALl and GREENWOOD l. c. p. 31.

whereas the anterior ones turn forwards in a bow. The fascicles terminate in narrow pointed tendons, which are inserted into the connective tissue above the angle of the mouth, into the upper lip, and on to the base of the trunk. The posterior fascicles are inserted slightly above the angle of the mouth about level with the lower margin of the proc. zygomaticus of the maxilla, partly level with the neighbouring ventral præorbicularis-fascicles, some of which, however, interlace between the nasolabialis-fascicles. In front the fascicles gradually grow longer and run, in a bow, into the upper-lip, partly crossing partly projecting between the fascicles of m. nasalis.

Some of the anterior fascicles (in Pl. 4 there are four such) are rather peculiar: Each fascicle passes into a long thin tendon, which runs forwards in a bow and passes into a new muscular fascicle which quite closely joins the portio inferior m. maxillo-labialis. In this way there is formed a succession of small »musculi digastrici«, stretched between the m. nasolabialis and the m. maxillo-labialis. To suppose that these fascicles are the remains of an original connection between the m. nasolabialis and the m. maxillo-labialis would be quite wrong. Indeed, our investigations have shown that these two muscles are independent, quite separate from each other. So there is nothing left but to regard these fascicles as a mere secondary connection between the said muscles. We must add however that in the Elk and the Zebu we have also found a connection between the m. nasolabialis and the m. maxillo-labialis, but developed in a way other than that in the Elephant. In the Ungulates we have generally found that the m. maxillo-labialis to a greater or smaller degree pierces the m. nasolabialis and in this place, which in the Elk and the Zebu is much in front of the face, some nasolabialis-fascicles are inserted into the tendinous slips of maxillo-labialis. (As to details v. the special descriptions in the Appendix; also compare Pl. 11, fig. 1 where these nasolabialis-fascicles are figured).

A little above the eye there is a small muscle, arising from the connective tissue outside the frontal bone, and passing obliquely backwards (Pl. 1 and 4). The fascicles are quite short and do not pass into the eyelid at all. The muscle is much more narrow on the right side of the head than on the left. We feel a doubt as to the explanation of this small muscle. Judging from its position we are most inclined to regard it as a very much reduced *m. supraorbicularis*; indeed, the direction of the fascicles does not appear to be in favour of this, but we have also in other places found such alterations of the course of the fascicles (compare e. g. the portio palpebralis sphinct. prof. in the Horse).

The orbicularis-group in the Elephant is composed of the same components as in the *Ungulates*. There is a m. orbicularis, post- and præorbicularis, supraorbicularis and nasolabialis. The orbicularis itself is peculiar in its complete want of circular fascicles, which seem to be constantly present in the *Ungulates*, though sometimes only in small numbers. In none of the *Ungulates* investigated was there so powerful a m. postorbicularis as in the Elephant, whereas the m. præorbicularis of the latter is somewhat reduced. This applies also to the m. supraorbicularis, which is very much reduced in the Elephant. As to the m. nasolabialis it is feebly developed in the Elephant, while it is generally well developed in the *Ungulates*. It is especially notable, that it has not contributed towards the formation of the muscular system of the trunk, but has been limited to the upper lip proper. The origin of the muscle is in the Elephant concentrated into a small portion of the frontal bone, while in the *Ungulates* it has a more considerable extension.

The account of the orbicularis-group in MIALL and GREENWOOD is very deficient; it evidently suggests a less careful investigation. — WATSON describes the orbicularis palpebrarum as consisting of »two sets of fibres, an internal and an external«; the internal portion is the proper »orbicularis« and is said to consist of circular fascicles (only interrupted in front); the »external portion« evidently corresponds to our m. præ- and postorbicularis. The m. nasolabialis (levator labii superioris WATSON) is said to consist of an anterior and a posterior portion. This we have not found at all.

3. MUSCULUS MAXILLO-LABIALIS.

Pl. 1: 2; 4; 14, fig. 2.

This muscle in the Elephant has been developed to a very high degree in consequence of its share in forming the trunk. On the whole dorsal side and part of the lateral face of the latter it forms a powerful, longitudinal muscular mass, arising from the cranium with two distinctly separated portions, the portio superior and the portio inferior.

The *portio inferior* is the smaller one (Pl. 2); it arises, with two or three short and narrow tendons, from the projecting corner of the maxillary bone just laterad of the foramen infraorbitale. The tendons pass into a rather narrow muscle, which goes straight forwards and very soon merges into the portio superior. Together with the latter it passes out upon the lateral face of the trunk and runs to its extreme distal end, where its outmost fascicles are inserted into the lateral circumference of the nostril. The origin is quite covered by the m. nasolabialis, whereas the first part of the muscle is partly covered, partly traversed, by the bundles of the m. nasalis. This traversing is most extensive on the right side, an anterior, rather broad bundle here thrusting up through the muscle and, as it were, separating it into a lateral and a mediad portion, which, however, in front of the m. nasalis very soon completely reunite (v. Pl. 2). On the left side only single and more disconnected bundles thrust up through the muscle. Just in front of the m. nasalis a small portion of the muscle appears between m. nasalis and the pars rimana m. buccinatorii (v. Pl. 1), but then, for a length of 15—20 cm along the trunk, it is again covered by the pars rimana. On the rest of the proboscis, unto the extreme distal end of this organ, the portio inferior lies quite superficially, covered only by the fascia, reaching to about the middle of the lateral face of the trunk (comp. Pl. 2 and the transverse section Pl. 14, fig. 2).

The *portio superior* is strongly developed. It extends to the median line and here fuses with the corresponding muscle of the other side, so that they together form a broad, powerful muscle, which from the front stretches down the dorsal, and partly the lateral, face of the trunk to its extreme distal end (Pl. 1). The superior portion arises from the frontal surface, rather far back, with a large and broad aponeurosis, which may distinctly be traced to the posterior part of the frontal bones, where it is intimately connected with the periosteum. Laterally this aponeurosis grows shorter and the origin stretches down the frontal and the maxillary bone just in front of the orbit, where it extends downwards till about level with the origin of the lig. palpebrale, so that it is here separated from the portio inferior by a rather broad interval, which is cuneate anteriorly and filled with adipose tissue. In the space in front of the eye the origin of the portio superior is covered by the nasolabialis. On the frontal surface, where the entire muscular body arises from the aponeurosis with a bowed, posteriorly convex line, the upper part thereof becomes fleshy on the level of the posterior angle of the eye, whereas the lower part thereof is fleshy almost from its origin.

We have no doubt that the muscle described here as the m. maxillo-labialis of the Elephant, really corresponds to this muscle in other Mammals, although indeed, in many respects, it shows considerable deviations from the account of this muscle in the Mammals, given in the General Part; deviations which, however, may be explained by the share this muscle has in forming the trunk. The place of the origin in relation to the m. nasolabialis decidedly shows that the muscle belongs to a deeper layer than the orbicularis-group; and as to origin and insertion the portio inferior is, in the main, as the corresponding muscle in the Mammals investigated, in which it arises from the maxillary bone laterad of the foramen infraorbitale and inserts itself into the lateral circumference of the nostril. Finally, it must be mentioned that relations between the portio inferior and the m. nasalis similar to those of the Elephant are found for instance in the *Ungulates*, in which the portio inferior is to a still larger extent traversed by the m. nasalis than in the Elephant. In the *Ungulates*, indeed, the muscle radiating in front like a fan offers a

much greater space for traverses than is the case in the Elephant, in which the muscle has become so narrow. That the maxillo-labialis in the Elephant has been developed in a manner rather different from that found in other Mammals is not surprising. The portio inferior radiating like a fan in other Mammals (vide e. g. the figures of Halmaturus, Horse, Dromedary, Tapir) has in the Elephant become a long narrow muscle, whereas, on the other hand, the portio superior has been developed into a powerful muscle, which has widened its origin to the very median line and posteriorly all over the fronto-nasal-region. It has been developed into an enormously powerful raising muscle for the trunk, a »m. levator proboscidis«, by which name all previous authors have treated this muscle without, however, trying in the least to explain its morphology. Such was also the case with the portio inferior which only was put down as a »lateral, longitudinal muscle« (vide e. g. MIALL).

The longitudinal muscular system formed by the maxillo-labialis on the dorsal and partly on the lateral circumference of the trunk is, as is known, able to develop an enormous force, just as it also has a considerable extent of motion, the trunk of the Elephant possessing a wonderful mobility. The working powers of a muscle are to a large extent determined partly by the number of muscular fibres it contains, partly by the length of the muscular belly; the former factor determines the force which the muscle is able to develop, the latter, however, the extent of its motion. In conformity to this the m. maxillo-labialis has in the Elephant obtained an enormous length and a considerable bulk of muscular fibres, which are to a large extent arranged in a most singular manner, quite different from that of the muscle in other Mammals.

The particulars in the structure of the muscle are as follows (comp. Pl. 1 and 2). It is very coarse-fibred and in its whole course along the trunk is covered by a very strong fascia (Pl. 4, where the fascia is dissected off on the proximal part of the muscle), which, on the proximal part of the trunk is separated from the corium by a layer of loose subcutaneous connective tissue, so that the skin may here easily be taken off. But very soon (about the end of the upper fourth of the trunk) the subcutaneous connective tissue begins to be reduced and it soon disappears, so that the corium throughout a very considerable length of the organ (more than the half) is intimately united with the fascia and cannot be separated from it. Posteriorly the fascia proceeds on to the face, where it covers the proximal part of the portio superior; here it gradually grows thinner and is at last lost in the connective tissue on the frontal surface.

In the proximal part of the portio superior, that is the part thereof which extends across the nasal cartilage with its muscles, from which the portio superior is separated by a layer of adipose tissue, — the intramuscular connective tissue is very powerfully developed, and forms thin fibrous longitudinal leaves, which extend upwards through the muscular body between the bundles and insert into the inner face of the fascia. Between these leaves there are deep grooves or rather canals, being closed above by the fascia, each of them quite filled up with coarse fascicles.

In front of the cartilaginous nose where the portio superior passes out upon the trunk these fibrous intramuscular leaves proceed in the fibrous leaves that belong to the radiate muscular system of the trunk (v. Plate 2 and Pl. 14, fig. 2). As we shall describe more fully below, there is in the trunk a considerable system of muscular bundles that, from the wall of the nasal canals, radiate upwards. They are arranged in long parallel rows and each such row passes into a thin fibrous leaf that is inserted into the inner face of the fascia. Between these rows of radiate muscular bundles with their fibrous leaves, there are formed long grooves or canals, in which the fascicles of both portions of the maxillo-labialis are placed, similar to the grooves limited by the leaves of the intramuscular connective tissue in the proximal part of the portio superior; the grooves on the trunk are deepest on its proximal part (some of the deepest grooves mea-

sured $1\frac{1}{2}$ —2 cm in height and were $1\frac{1}{2}$ cm broad just below the fascia), whereas they gradually grow lower and narrower towards the distal end of the trunk.

These leaves present many special peculiarities (fig. D). Some of them are of considerable length, and may be traced far down the trunk with long intervening grooves; but no leaf reaches continuously from the upper end of the trunk to the lower one. Other leaves are short (vide e. g. *a* and *b* in fig. D), some of the shortest we found measured 2—3 cm. Now, if we follow such leaves it is found that they suddenly stop with steep, truncated ends (v. *a* in fig. D). At a shorter or longer distance distad of this, one or two new leaves begin (v. *b* in fig. D) which may then be traced for a shorter or longer extent. Hereby there arise many singularities in the course of the grooves. If we follow a groove (vide e. g. the grooves 7, 15, 17, 22, 23, 24 in the fig. D) then, after a shorter or longer course we suddenly meet a leaf that arises from the trough of the groove and at the sharp edge of which the groove, as it were, splits into two. Sometimes this is repeated several times in the course of a groove (v. e. g. the grooves 7, 15, 17 in the fig. D) so that it is divided into several parallel grooves. Sometimes we see how a groove splitting into two by a leaf that juts out from its bottom, reunites at the distal end of this leaf (v. e. g. the groove 7; the upper *b*). Besides these peculiarities, determined by the length of the leaves, and by their origin, there are others which arise by the formation of abundant »anastomoses« between the leaves. The leaves unite or amalgamate; and in details this is done in several ways. Very frequently two leaves are found approaching each other, uniting for a short space then parting again (vide e. g. the grooves 1, 2, 6, 8, 10, 13, 16, 17, 23). The groove is in this way interrupted and at the »anastomoses« the two leaves are firmly connected by short, tight fascicles of connective tissue. Sometimes this is repeated several times in the course of a leaf so that it »anastomoses« now with its mediad now with its laterad neighbouring leaf (v. e. g. the plate between the grooves 1 and 2). In other places there will be found two (v. e. g. the grooves 5, 11, 14, 15, 17, 24) or three leaves (v. the grooves 21—22) amalgamating so that the intervening groove or grooves are closed. Most frequently this form of »anastomoses« appears at the short leaves, most of which join the long neighbouring leaves, but it is also found now and then between the latter (v. e. g. the grooves 11, 24). The leaf formed by the anastomose then proceeds in order to divide after a shorter or longer course (v. the grooves 15, 21) and to anastomose again etc. Upon the whole, there will very frequently be found divisions of leaves, often in such a manner that from the lateral faces of a leaf others arise which generally stop after a shorter or longer course parallel to the leaf of origin (v. e. g. the grooves 7, 15, 17); it looks as if a secondary, proximally closed groove had, as it were, been cut off from the main-groove, reuniting the latter at the distal end of the secondary leaf.

On the dorsal face of the trunk and on the neighbouring parts of its lateral circumference there is formed in this way a system of longitudinal fibrous, or muscular-fibrous leaves radiating through the wall of the trunk. Between them they include grooves, in the course of which, however, many peculiarities occur, brought about by the relations of the leaves mentioned above. In these grooves the muscular portion of the maxillo-labialis is imbedded, and so it becomes evident that an extremely large surface of origin and insertion is afforded the muscle by this arrangement, the leaves serving as surfaces for attachment.

By the whole system of the radiate leaves the muscular body is, as it were, divided into parallel, longitudinal sections each consisting of a greater or smaller number of coarse bundles, which may most easily be dissected and followed along their whole length. The length of such sections differs considerably. We found them up to 12—15 cm long. The proximal sections arise from the aponeurosis on the nasal surface and project into the grooves, where they show the following insertions: Some fascicles end in short tendons, from the distal ends of which new fascicles

Fig. D. Diagram of a small portion (greatly enlarged) of the longitudinal leaves on the proboscis of the Elephant, between which the fascicles of the *musculus maxillo-labialis* run. Seen from the surface, the skin and fascia having been dissected off. The upper end of the figure is the proximal. On the left side of the figure the *leaves* only are represented (the black lines); in the right half also the muscular fibres are indicated (the red lines). The red spots are the points of origin and insertion of the muscular fibres into the bottom of the grooves between the leaves. — The letters and ciphers see the text p. 32.

arise which insert themselves, either into the bottom of a groove or into the face of a leaf. In this way small »musculi digastrici« are formed which indeed are rather thin; but as we, as a rule, always found this arrangement in the longest fascicles, these »digastric« muscles could span quite a considerable length. The other fascicles of a groove showed very different lengths, and gradually inserted themselves, under their course in the groove, partly into the bottom of the latter partly into the neighbouring leaves (fig. D). According as the bundles of such a section fail, new ones arise from the bottom or the walls of the groove, to insert themselves again in the same way as the former. No fixed rules were found as to the ways in which such bundles arose and were inserted: Bundles arising from the bottom of a groove might again insert themselves into the bottom of the same groove whereas others inserted themselves into the leaves. Bundles arising from a leaf often inserted themselves again into the same leaf, whereas others inserted themselves into the bottom of the groove. There were, as we have mentioned, numerous »anastomoses« and divisions of the leaves, and these points of anastomoses and divisions are constantly used by the fascicles partly as insertion partly as origin. Where the leaves after such a formation of an anastomosis again part from each other and continue the course, a special arrangement is found. Through the point of anastomosis there stretches a little thin aponeurosis, which in the proximal section serves as insertion, in the distal one as origin, of part of the fascicles of the respective sections; here we again find a formation that reminds us of the digastric muscles, only with the difference that the intermedial tendon is here fastened to the two leaves that limit the section. Finally it must still be mentioned that the free, sharply truncated edges with which the leaves end, or begin, are likewise always used by the fascicles for insertion or origin, either on one or on both faces, so that in such places there is found a typical semipennate or pennate arrangement of the bundles.

It is evident from this account that the maxillo-labialis possesses a most complicated and also a quite special muscular structure; the formation of the trunk has been of singular influence on the structure of this muscle.

4. THE BUCCINATOR-GROUP.

Pl. 1, Pl. 2, Pl. 3, Pl. 4; Pl. 16, fig. 16.

This group contains all the constituents mentioned in the General Part. First one finds the *m. buccinatorius* itself, in which both transverse and longitudinal fascicles can be distinguished, and its subdivisions the *pars rimana* and the *pars supralabialis*. Further the *m. nasalis* and the *m. mentalis*. But in many respects this muscular group presents peculiarities which are in the closest connection with the not insignificant share this group has in the formation of the muscular system of the trunk, especially its ventral and partly its lateral parts.

The part of the *m. buccinatorius* which lies in front of the anterior margin of the *m. masseter* and the *m. temporalis*, and also forms the base of the cheek, has a rather strange external shape. It forms a thick, rounded, closely united, muscular mass (comp. Pl. 2 and Pl. 4); it is high but very short, and in the specimen we dissected, of about the circumference of a clenched fist. Covered by this muscular mass are the *gl. buccales*, which are present in so great a number and occupy so considerable a circumference that they are not altogether without influence on the formation of the *m. buccinatorius* (v. Plate 3). Above, between the muscle and the laterally much expanded maxillary bone a fissure is formed (Pl. 2), 7—8 cm deep and a couple of cm broad, filled with adipose tissue; the *n. facialis* runs superficially in this rather considerable mass of adipose tissue (Pl. 1).

The buccinator arises from the hindmost part of the maxillary bone, a little behind and above the upper molar, further from the hindmost part of the mucous membrane of the cheek and from the lower jaw on the inside of the ramus ascendens, a little behind the lower molar. From this line of origin there arises a high, flat, but in the lower half, however, a rather full mu-

scular body, whose fascicles are all longitudinal, that is, form only one layer (comp. the diagram Pl. 16, fig. 16). If one follows the fascicles onwards, it appears that the part arising from the lower jaw, the *mandibular portion*, soon distinguishes itself from the dorsal portion of the buccinator (arising from the maxillary bone and the mucous membrane). And this is partly owing to the fact that it grows thicker, but partly, and more particularly, because some of its fascicles alter their direction. After having reached the anterior margin of the *mm. masseter* and *temporalis*, the upper fascicles of the mandibular portion turn upwards, transversally crossing the longitudinal fascicles arising from the maxillary bone and the mucous membrane, and becomes inserted into the maxillary bone above the mucous membrane (v. Plate 4 where the mandibular fascicles appear very distinctly a little in front of the *m. temporalis*; they are seen crossing the upper portion, which is faintly seen in the depth). As an immediate continuation of these upwardly turning, now transverse, fascicles there follows a number of coarse thick bundles, which, in the shape of a transverse layer, arise from the maxillary bone, turn outwards forming the bottom of the deep fissure under the maxillary bone, mentioned above, and then bend downwards covering about the upper half of the buccinator. The hindmost fascicles — those which join the fascicles of the mandibular portion — are the longest and coarsest and thrust in between the longitudinal fascicles that lie below, where they end in short pointed tendons. In front the fascicles gradually grow shorter and the foremost do not, with their short pointed tendinous ends, reach farther down than to the height of the angle of the mouth; from here the transverse layer proceeds a short distance into the upper lip, where the fascicles are arranged in several layers, the superficial ones of which arch over the posterior part of the longitudinal fascicles of the upper lip, whereas the deep ones cross them and project between them. The fascicles of the platysma thrust themselves in between the fascicles of the transverse layer of the buccinator in several rows, joining the longitudinal fascicles of the deep layer of the buccinator (Pl. 4). Immediately in front of the transverse layer, partly crossing its fascicles, steepens out a thick mass of thin longitudinal fascicles which make their way down into the under lip, in the hindmost part of which they end with thin pointed tendons (Pl. 4).

While, as described, the upper fascicles of the mandibular portion alter their direction and pass into a transverse layer, the rest — indeed the greater part of the fascicles of this portion — proceed further on in longitudinal direction. The surface of the free part of the buccinator thus acquires quite a curious appearance (Pl. 2): in about its upper half a transverse layer is seen, in the lower half a longitudinal layer — both of them originating from the mandibular portion and forming the superficial layer of the buccinator. In front the longitudinal fascicles gather together in the under lip, where the uppermost, superficial fascicles end in the connective tissue with short pointed tendons. The rest, and indeed the principal mass, as one muscular body, turns upwards and inwards, bending anteriorly around the great united mass of the undermost glands of the cheek, and inserting themselves onto the lower jaw (in Pl. 3 the greater part of these fascicles are seen close in front of the glandular mass). Straight through the longitudinal layer a broad somewhat irregular »in-scriptio tendinea« passes dorso-ventrad; the fascicles that come from behind end with pointed tendons in this stripe and from it arise the anterior fascicles. For some fascicles the tendons may be prepared out of the tendinous stripe and then appear as an intermedial tendon between a hindmost and a foremost fascicle. The tendinous stripe does not extend through the whole height of the longitudinal layer; in the lower part of the longitudinal layer the fascicles traverse (Pl. 4).

In the other portion of the buccinator, arising from the maxillary bone and the mucous membrane, — which we term the *maxillary portion* — the fascicles are arranged longitudinally throughout their whole course. Only in front, where a great part of them thrust down in the under lip, the direction is a little downward. These longitudinal fascicles run in front inside

the mandibular portion described; where the latter forms the transverse layer that is by a layer of connective tissue distinctly separated from the underlying longitudinal fascicles, whereas in the lower half of the buccinator the longitudinal fascicles of the maxillary portion, quite closely, and without any limit whatever, join those of the mandibular portion. Thus the buccinator, in its upper half, consists of two distinctly separated layers: a superficial transverse layer, and a deep longitudinal layer, — in its lower one, however, only of a longitudinal layer (comp. Pl. 16, fig. 16). As to the longitudinal fascicles in the maxillary portion it must however be remarked that they together form a rather considerable mass as under their course numerous new fascicles are added, arising, partly from the maxillary bone, and partly from the external surface of the mucous membrane. The latter forms a large and somewhat oblique fold (Pl. 3) which juts far out being on both surfaces used partly as insertion partly as origin of numbers of the deep longitudinal fascicles of the buccinator.

The deep »longitudinal layer« of the buccinator, — that is, the longitudinal fascicles belonging to the maxillary portion — proceeds onwards as well in the upper as in the under lip forming, immediately under the skin, a brim of fascicles that run longitudinally through the lips: *pars rimana* (in Pl. 4 this brim is seen in the upper lip; in the under lip it is only visible posteriorly as the upper lip projects so far to the side that it covers the upper part of the under lip).

If we first examine the under lip, we see, in Pl. 4, the lower part of the deep longitudinal fascicles projecting in rather a considerable number partly under, partly between, the fascicles of the transverse layer, after which they bend obliquely downwards in the under lip ending here with short pointed tendons, inserted to the skin. The fascicles, however, reach only a short way — a few centimeters — into the under lip; but at the same time new fascicles have been added arising below the angle of the mouth (Pl. 16, fig. 16). The new fascicles run onwards in the under lip, at first mixed up among the fascicles of the buccinator, and where the latter end the new ones continue their course forwards as an immediate continuation thereof. The new fascicles extend, for a shorter or longer distance, forwards into the lip, but as they end, other fascicles are added, which continue the course farther on. In this way there is formed a continuous brim — 1 or 1½ cm high, — of longitudinal fascicles which may be followed forwards to about the base of the free spout-like termination of the under lip where the fascicles end, at the same time spreading somewhat.

The upper fascicles of the deep longitudinal layer of the buccinator proceed above the angle of the mouth into the upper lip (Pl. 4), where, after a short course, they end with short pointed tendons and in a way similar to that which obtains in the under lip: new fascicles are added forming an immediate continuation of the fascicles of the buccinator. In this way there is formed a continuous border of longitudinal fascicles, but in the upper lip they are present in far greater numbers than in the under lip, so that the border becomes much broader; it, however, is not very thick. The fascicles reach down to the free margin of the upper lip, running in a bow corresponding to the form of the lip; they proceed outside the fold around the incisor reaching in front thereof out upon the trunk, where they continue their course down to its very point, forming a superficial muscular layer on its ventral, and partly its lateral face (Pl. 1, comp. Pl. 16, fig. 16).

Before we follow the further course of the buccinator upon the trunk we will compare the part already described with the buccinator in the other Mammals examined, as is mentioned in the General Part. We find then in the Elephant the two layers generally found, a superficial transverse layer and a longitudinal layer, which posteriorly at the origin pass so closely into each other that they only form one layer. We have found the same in several Ungulates (Tapir, Horse, Boar, Wapiti, Elk, Zebu), and in several figures (Pl. 8, fig. 1 and the schemes Pl. 16, fig. 1—15) the details of the relations of the fascicles to each other are given. A comparison shows then that the state of

things in the Elephant recalls most nearly that found in the Pig (Pl. 16, fig. 15); ventral longitudinal fascicles gradually taking the transverse direction. In the Elephant, however, the transverse layer is rather considerably reduced; it only occupies about the upper half of the buccinator, whereas in return the longitudinal layer, which owing to the reduction of the transverse layer lies superficially on about the lower half of the buccinator, is by far the more important and powerful. Indeed, it is probable that the reduction is in a close connection with the peculiar form of the cheek in the Elephant. For the cheek is short and — what must be particularly emphasized — high, and has rather a considerable mass (mucous membrane, glands, muscles, connective tissue) so that the fascicles of the transverse layer run in a great arc over the glands and the longitudinal fascicles; so the buccinator will certainly most easily be able to perform its chief function — that is, to hold the food in between the grinding surfaces of the molars during the mastication — by means of longitudinal fascicles. We shall in this respect also refer to the buccinator of the Dog (v. the General Part p. 27 and comp. Pl. 16, fig. 17) in which animal the cheek, as is known, also is very short; here the transverse layer is reduced too since only the *pars rimana* remains, whereas all the rest, the fascicles extending from upper to lower jaw, is wanting. — By the reduction of the transverse layer in the Elephant its share in the formation of the *pars rimana* has also suffered; indeed the layer proceeds a short distance into the upper lip but its fascicles have the same direction as in the cheek and does not bend round the angle of the mouth as is the case in other Mammals. So the *pars rimana* in the Elephant is exclusively formed by the longitudinal layer of the buccinator. That it is really the *pars rimana* which is found in the lips we think may be concluded from the fact that the longitudinal layer of the buccinator in several other Mammals may also contribute to the formation of the *pars rimana* (Wapiti, Zebu, Swine, Erinaceus, Rabbit).

As we have said, the *pars rimana* proceeds down upon the trunk throughout its whole length. The origin of the fascicles proceeds, in front of the incisor, from the skin of the fold of the upper lip round the tooth, upon the ventral face of the root of the trunk. On the trunk the fascicles arise from a rather powerful aponeurosis which covers its ventral face. On the proximal part of the trunk it may be rather easily separated from the skin as there is a thin layer of subcutaneous connective tissue; but distad this layer is gradually reduced, so that the aponeurosis is here closely united with the corium and only with difficulty may be dissected out. The line of origin of the fascicles is on the upper half of the trunk only a short distance from the median line, but under its further course it turns gradually more and more laterad, reaching, on the distal part of the trunk, out to the very lateral margin of the ventral face¹⁾; a broader and broader piece of the ventral face of the trunk is therefore covered by the aponeurosis (Pl. 14, fig. 9). From the whole of the margin of the aponeurosis the fascicles arise and form a continuous superficial layer in which the fascicles run obliquely distad and dorsad, lying on the ventral and partly on the lateral circumference of the trunk (Pl. 1). On the proximal part of the trunk, where the fascicles are thick and coarse, they run rather steeply dorsad so that they soon turn from the ventral on to the lateral face (Pl. 4), but the farther one gets out upon the trunk the more they take the direction obliquely forwards and on the most distal part even so much that they almost become longitudinal. The fascicles are inserted into the fascia, which covers the maxillo-labialis; and upon the proximal end of the trunk, where the fascia and the skin may easily be separated, this insertion into the fascia is easily demonstrated (Pl. 4); but farther distad, where the fascia and the corium melt together, the fascicles are

¹⁾ As long as the trunk is still covered with skin it has, — most distinctly on its distal part — as is well known, an almost level ventral face, which, on each side, by rather a projecting, notched, and fairly sharp edge is separated from the smoothly arched dorso-lateral face; this outer relief is chiefly called forth by the skin, whereas the muscles — and particularly the *pars rimana* — only slightly contributes to this. When the skin is dissected off, the trunk assumes a more cylindric or rather conical form.

closely connected with the skin. On the proximal part of the trunk the fascicles reach highest up, almost to the very dorsal face, here covering part of the *m. maxillo-labialis*; but in its further course the muscular body grows narrower, the line of insertion does not extend so far dorsad on the lateral face of the trunk, where it only reaches up to the lateral margin of the *maxillo-labialis*, corresponding to about the middle of the lateral face of the trunk (Pl. 1). At the distal end, where its fascicles are almost longitudinal, the muscular body has become quite narrow, and united with the *maxillo-labialis* so intimately that the limit between them can hardly be indicated (Pl. 1).

If the *pars rimana* is removed, there is found under it a continuous layer of fascicles throughout the whole length of the trunk, and crossing the direction of the fascicles of the *pars rimana* (Pl. 2). This deep oblique layer takes its origin from the front end of the intermaxillary bone and from the inside of the base of the incisor; but from this point the line of origin proceeds downwards upon the proboscis for the whole length — along the margin of the *maxillo-labialis*, the fascicles arising from inside the lateral border of this muscle (Pl. 14, fig. 2). This deep oblique layer is the *pars supralabialis m. buccinatorii* of the Elephant. Indeed, it does not form any direct continuation of the buccinator, its origin appearing with a certain independence, but something similar we have also found elsewhere e. g. in the Tapir. And the manner in which the hinder end of the muscle takes its origin from the intermaxillary bone and the position of the muscle in relation to the *pars rimana* are those of the *pars supralabialis* (comp. also the *pars supralabialis* of the Elk, where sometimes an anterior portion of the fascicles of the *supralabialis* also does not take its origin from the bone).

As to the details of the *pars supralabialis* in the Elephant we shall further mention the following: From the whole line of origin the fascicles run obliquely forwards (distad), then turning in a semicircle on to the ventral face of the trunk (Pl. 14, fig. 10). Thus they cross the fascicles of the *pars rimana* and this crossing is distinctly pronounced throughout the whole course of the muscles. On the basal part of the trunk where, as we have said, the fascicles of the *pars rimana* turned very steeply on to the dorsal face almost approaching to the transverse direction, the fascicles of the *pars supralabialis* are found running only a little obliquely forwards approaching most to a longitudinal direction (comp. Pl. 1 and 2, Pl. 14, fig. 9 and 10). While the fascicles of the *pars rimana* in their further course took a less and less oblique direction, the reverse obtains with the fascicles of the *pars supralabialis* as they take a steeper and steeper course, on the distal part of the trunk closely approaching to the transverse direction. The fascicles of the *pars supralabialis* are inserted into the deep face of the aponeurosis covering the ventral face of the trunk and serving as origin of the *pars rimana*, and reach almost to the very median line. So then, only a narrow stripe of the aponeurosis remains free between the lines of insertion for the right and left *pars supralabialis* (Pl. 14, fig. 2 and 10).

The *m. nasalis* (Pl. 1—4) arises from the intermaxillary bone behind, above and inside the base of the incisor. The foremost rather thick part (Pl. 3), which takes its origin from inside the base of the incisor, extends obliquely upon the proximal part of the ventral side of the proboscis, covered by the basal portion of the *pars supralabialis m. buccinatorii*; the ends of its fibres are directed upwards and forwards. The rest of the muscle is as usual situated on that part of the face lying above the upper lip. It forms a large mass of rather short and thick fascicles; in detail there is some difference between the two halves of the head, examined by us, and this fact makes it desirable to mention each separately. In the right half (Pl. 1, 2 and 3) the fascicles arise remarkably regularly, in several rows, one above the other; altogether 5 such could be dissected out, the 2^d—4th of which are seen in Pl. 2, whereas the fifth is figured in Pl. 3. The 1st (undermost) row arises from the ventral face of the intermaxillary consisting of rather a considerable number of fascicles that run transversely outwards, then turning in a semicircle upwards in the upper lip, where they partly thrust out above, partly cross

in between, the fascicles of the *pars rimana* (in Pl. 4 this 1st row is figured on the left half). From each of the lines of origin of the following 4 rows the fascicles radiate upwards like a fan, and as the lines of origin lie higher and higher up and the fascicles of each row have about the same length, the fascicles appear quite regularly imbricated, the short, pointed, tendinous ends of the fascicles of one row projecting somewhat above those of the one lying beneath. In the 4th row, however, the fascicles are so long that they quite cover the 5th one. The fascicles of the 1st—4th row are inserted into the skin of the upper lip, and of the root of the trunk. The *m. nasalis*, as mentioned, crosses up through the portio inferior of the *maxillo-labialis*, and on the right side this crossing is done in such a way that an anterior, rather broad, fascicle of the 4th row thrusts up through the portio inferior so that this, as it were, is divided into two portions which, however, soon are connected again (Pl. 2). — The 5th row (Pl. 3) arises from the dorsal face of the intermaxillary, and forms the most important part of the whole muscle. It measures about 2 cm in width (thickness). The fascicles radiate upwards to the fascia on the trunk, where they are inserted, but are during their course crossed by the radial fascicles (*m. recti*, v. *infra*) of the trunk, which are arranged like leaves and project between the fascicles of this row. It is a very intimate crossing that is formed by these two muscles since in each interval between the fascicles of the 5th row, a plate of radial fascicles projects (Pl. 3). The 5th row is anteriorly continued by the foremost part of *nasalis*, mentioned above, which arises from inside the base of the incisor.

In the left half (Pl. 4) of the head examined as to all essential points the same is found as in the right half, but the fascicles neither arise, nor are arranged, so regularly as on that side; the whole forms a more continuous muscular mass consisting of rather coarse fascicles with plenty of intramuscular adipose connective tissue, so that each fascicle may easily be dissected out. On this side there is also a crossing of the portio inferior *m. maxillo-labialis* but with more scattered and fewer fascicles, than on the right side. The relation to the radial fascicles is the same as on the other side. The most ventral fascicles penetrate the *pars rimana* of the upper lip; in Pl. 4 the ends of these bundles are distinctly seen.

The *m. mentalis* (Pl. 1—4, espec. 3 and 4) forms a very considerable mass of fascicles that in the usual way arise from the anterior part of the lower jaw, radiating to the skin of the same. Posteriorly the muscle intimately joins the superficial longitudinal fascicles of the *m. buccinatorius* — so intimately that, in reality, they form an immediate continuation of these fascicles. This is distinctly seen in Pl. 4, where the ends of the fascicles of the *mentalis* are seen thrusting out from the connective tissue in the under lip. The fascicles radiate towards the skin, and are in the main arranged similarly to the fascicles of the *m. nasalis*, that is, in rows (v. the cut in the under lip in Pl. 3).

The buccinator-group has been examined most deficiently by previous authors. In the paper of WATSON there is a very short and rather vague description of the *m. buccinatorius* itself. MIAL and GREENWOOD evidently have not examined this group at all, as they content themselves with quoting WATSON. As to the muscles of the trunk; previous authors have, of course, all found the two oblique layers, just as they also all of them know the longitudinal (*m. maxillo-labialis*) and the radial fascicles; but the description shows, clearly enough, that they have by no means dissected with the necessary minuteness. The consequence of this, indeed, is that their conception of the whole buccinator-group in the Elephant is essentially different from ours in nearly all respects. None of them have realized the intimate connection of the muscles of cheek, lip, and trunk, but describe these portions separately as independent muscles. To limit ourselves to MIAL and GREENWOOD, whose investigations evidently are the most thorough hitherto given, we find that they acquiesce entirely in CUVIER's old statement; according to which, there is a superficial layer with fascicles running more or less longitudinally, and a deep layer with radial and transverse fascicles. Again, the »longitudinal muscles» are on each side divided into an »anterior», a »lateralis» and a »posterior» one. The anterior or the »levator proboscidis» is our portio superior *m. maxillo-labialis*. The »posterior» muscle or »depressor proboscidis», consisting of 2 layers of oblique fascicles, arranged in crossing direction, evidently corresponds to our *pars rimana* and *pars supralabialis*.

Finally, the *m. longitudinalis lateralis* is mentioned. This is said to consist of 2 portions: »one is derived from *orbicularis oris*, the other springs from the anterior margin of the orbit. They are inserted by a series of slips between the anterior and posterior longitudinal muscle along the proximal half of the proboscis». One of these portions — the one that arises »from the anterior margin of the orbit« — evidently corresponds to our *portio inferior m. maxillo-labialis*; but what the other portion represents we cannot imagine.

We have mentioned the investigations of the previous authors in such detail to show the limited nature of their scope: It is a merely descriptive treatment — moreover very deficient, and full of mistakes — and not the least attempt has been made to establish the morphology of the muscles of the trunk.

5. THE *M. LATERALIS NASI*

(Pl. 3; Pl. 14, fig. 11)

is powerfully developed, and consists of coarse fascicles with plenty of adipose intramuscular connective tissue, so that the fascicles may easily be dissected out singly. The origin of the muscle forms a bow along the lateral and dorsal circumference of the bony entrance to the cavity of the nose: and farther on in the median line from the cartilaginous nose (septum). If we begin at the lateral circumference, the anterior fascicles arise from a firm and compact mass of connective tissue, in front of the orbit, and covered by the *m. maxillo-labialis*. Farther up the fascicles arise from the *proc. nasalis* of the intermaxillary bone and from this point the line of origin turns on to the nasal bone (Pl. 14, fig. 11). The fascicles arising from the nasal bone are separated by a space which was filled with adipose tissue from those coming from the intermaxillary. The nasal fascicles unite, like a fan, and are inserted into the mucous membrane of the nose, whereas those from the intermaxillary run more transversally inwards, and also are inserted into the mucous membrane. The muscle proceeds farther down upon the cartilaginous nose, where it arises, a little from the median line, forming a flat, rather powerful muscular body; which with its transverse fascicles covers the greatest part of the cartilaginous wings of the nose, inserting themselves to the surface of these wings near the margin. In front, in the median line, the right and left muscular bodies unite so intimately that no limit can be shown between them.

That the muscle described is the *m. lateralis nasi* is beyond all doubt. The part thereof which arises from the lateral, and dorsal circumference, of the bony entrance of the cavity of the nose, and is inserted into the mucous membrane of the nose, corresponds exactly to that which we have found in the other Mammals examined. This part of the muscle is, in the Elephant, uncommonly well developed, and evidently serves to pull the soft nasal wall outwards, and, by this means, to increase the space in the cavity of the nose at this spot. Thus then it is certainly active when the animal drinks (sucks up the water into the trunk).

The part of the muscle which lies on the cartilaginous wings of the nose is somewhat different, in so far as its fibres do not insert themselves into the mucous membrane of the nose itself; but to the cartilaginous wings of the nose. The only one of the Mammals examined by us in which we have found anything similar, is the Horse (v. Appendix) where a rather powerful muscle is stretched between the freely moveable cartilaginous wings of the nose (the *m. transversus nasi* of the Veterinarians, comp. Pl. 8, fig. 1). In our examination of the Horse we found that this *m. transversus nasi* is nothing more than the anterior part of the *m. lateralis nasi*, which has here lost its insertion into the mucous membrane of the nose, and has become instead inserted into the wings of the nose. The examination of the Elephant fully confirms this view. The muscular body lying on the wings of the nose is a direct continuation of the part of the *m. lateralis nasi* that arises dorsad of the entrance to the nose. Between the Horse and the Elephant there is, however, this difference, that in the former, the fascicles run without interruption from one wing of the nose over the median line to the other; in the Elephant on the contrary this »*m. transversus nasi*« has

not been so much differentiated — or: it shows a more primitive feature, as it still consists of a right and a left muscular body each forming a direct continuation of the corresponding *m. lateralis nasi*; only in front the two muscular bodies meet.

6. THE *M. RECTUS NASI*

(Pl. 3; Pl. 14, fig. 2, 5, 6, 7 and 8)

is immensely developed, and forms a powerful system of fascicles that extend through the whole length of the trunk radiating outwards from the whole circumference of the long nasal tube (Pl. 14, fig. 2). In order to study more closely the details of the arrangement of the fascicles of the whole of this system we have used a series of transverse sections cut in different parts of the trunk, from its very root outwards to its tip. The fascicles show the following arrangement.

On a section (Pl. 14, fig. 5; comp. Pl. 3) immediately in front of the cartilaginous nose there are seen fascicles which, from the dorsal circumference of the nasal tube, radiate dorsad. The fascicles are long, not very closely set, and directed a little obliquely, dorso-distad; they are arranged in parallel longitudinal rows ending in the connective tissue under the *portio superior m. maxillo-labialis*. The spaces between them are filled with adipose connective tissue. Mediad, they pass smoothly into short fascicles that run transversely from one nasal tube to the other. These transverse fascicles are found through the whole of the soft septum between the nasal tubes, in which they lie arranged in small groups separated by rather compact connective tissue. If the dorsal fascicles are followed laterad, they are found to pass immediately into a close mass of thick fascicles, which, from the whole lateral circumference of the nasal tube radiate laterad. These fascicles are arranged, fairly regularly, in transverse rows, and project between the fascicles of the *m. nasalis* (Pl. 3). Proximad, these lateral fascicles border on the *m. lateralis nasi*, and there is so smooth a passage between these two muscles that no limit at all can be shown between them. If the lateral fascicles are traced ventrad, they are found to be continued by fascicles, that, from the whole ventral circumference of the nasal tube radiate ventrad, and are inserted into the dorsal face of the intermaxillary bone. These ventral fascicles are short, the distance between the nasal tube and the dorsal face of the intermaxillary being small.

In the next part of the trunk the nasal tube rises more and more from the intermaxillary bone, and, on a section at the anterior margin of this, the following is found (Pl. 14, fig. 6): Dorsad, the fascicles radiate upwards, standing closer than in the section first described; laterally they pass smoothly into the laterad radiating fascicles, which thrust themselves out between the fascicles of the *m. nasalis*. Finally there is found, ventrad, a high, and thick mass of close standing fascicles which are inserted into the intermaxillary bone. These fascicles border laterad onto the *m. nasalis* and are so intimately annexed to them, that hardly any limit can be shown. We cannot decide whether this intimate cohesion of the rectus, and the nasalis, and the equal close connection of the rectus and the lateralis nasi mentioned under the description of the first section may be conceived of as demonstrating a genetic connection between these muscles. In the Elephant, where the fascicles are so coarse that each of them may easily be dissected out, this cohesion is very conspicuous; but we must admit that we have not sufficiently examined the relations of these muscles in other Mammals, where the thinness of the fascicles greatly impedes the examination. In itself, it is by no means unlikely that the said muscles belonged to, or were developed from, a common system; but the isolated observations we have made do not justify any definite conclusion. The more so, as we are here dealing with an animal whose muscular system has in so many respects undergone most radical changes. Indeed, there is the possibility as well, that the said connection of the muscles is but of a mere secondary nature. — On the section described, there are also transverse fascicles in the septum between the nasal tubes. In about the dorsal half

none were found, whereas they were numerous in the ventral half. And, moreover, they proceed some distance down, ventrad of the septum, where they partly thrust between, partly pass into, the ventral fascicles.

The next section (Pl. 14, fig. 7) is cut just in front of the point of the under lip. The radiating fascicles are here seen in the dorsal, lateral, and ventral circumference of the nasal tube. The lateral and ventral ones are not present in quite so great a number as in the second section, and the ventral ones have become longer and run a little more curved ventrad. On the other hand, it is to be noted that, in the space from the 2nd to the 3rd section, a considerable increase of the transverse fascicles has taken place. Through the whole height of the septum (which, however, is not considerable in this place) these fascicles are found, and we draw particular attention to the fact that they proceed a considerable distance down, below the nasal tubes, where they form a close mass of thick, transverse fascicles, which, with their ends somewhat turn in a bow, upwards, ending in the connective tissue inside the ventral radial fascicles.

Finally, we come to a section about the middle of the trunk (Pl. 14, fig. 8): Here we see the radial fascicles from the dorsal, lateral, and ventral circumference of the nasal tube as a continuous, radiating, muscular mass. The ventral fascicles are here not much longer than the dorsal ones. Through the septum, and below it, the transverse fascicles are found. In the septum itself, they are numerous, whereas much fewer are found below it than in the former section. This likeness in the main appears again in the sections throughout the distal half of the trunk; the fascicles, however, gradually decreasing more and more in length.

We must yet add that we have not contented ourselves with simply cutting through the trunk in the places described, but have in reality made a great number of sections throughout its whole length. By this means we have found that the transition from the likeness offered by one section to that offered by another is quite gradual.

Now, if by means of the sections described, we try to form one picture of the whole *m. rectus nasi* the result will be as follows: Through the whole length of the trunk there is a large system of radial fascicles. They arise from the mucous membrane of the nasal tube radiating thence dorsad, laterad, and ventrad. The dorsal and ventral fascicles bend into the septum, and run here from one nasal tube to the other. In the details there is some variation in the length and more or less close arrangement of the fascicles; this is especially the case with the proximal half of the trunk and is evidently in close connection partly with the alteration of the form of the lumen of the nasal tube partly with its situation in the section, and partly with the relations of the trunk to the neighbouring parts. As to the last it must especially be remarked that the ventral fascicles, in the space where the trunk overlies the intermaxillary bone, insert into the bone, which is not otherwise the case with the *rectus nasi* generally. Further it must be remarked that from about the anterior margin of the intermaxillary bone and farther down through the rest of the trunk the transverse fascicles proceed down in the portion below the nasal tubes and are particularly numerous in the proximal part of the trunk.

As to the insertion of the fibres we see in the sections that the dorsal and lateral fibres pass into thin, short tendons that thrust up between the fascicles of the *m. maxillo-labialis* (Pl. 14, fig. 2) and insert themselves into the deep face of the fascia outside this muscle. The ventral fascicles of the basal part of the trunk are inserted, as described, into the intermaxillary bone. On the rest of the trunk by far the greater number end in the connective tissue inside the portio supralabialis, whereas a smaller number may be followed somewhat outwards into the connective tissue between the fascicles of this muscle (Pl. 14, fig. 2).

Further, our examinations show that the *rectus*-fascicles are arranged very regularly in longitudinal rows, separated from each other by adipose connective tissue. On the whole dorsal and lateral circumference of the trunk — that is, in the whole extent of the *m. maxillo-labialis* — these rows of fibres pass into

low aponeuroses that extend up through the *m. maxillo-labialis* (Pl. 2) and so become inserted into the fascia — the thin short tendons mentioned above in the description of the section being in reality aponeuroses, each aponeurosis being common for one row of fascicles. We have already described these aponeuroses in full detail, when dealing with the *m. maxillo-labialis*. And what is said of their arrangement, and course, also applies to the rows of fibres. Here we have only one addition to make: Between the rows of the fibres with their aponeuroses grooves are formed; about the inner half of each of these grooves is filled with adipose tissue, so that only a little more than the outer half is occupied by the fascicles of the *m. maxillo-labialis* (Pl. 14, fig. 2).

The previous authors (v.e.g. MIALl and GREENWOOD, HARRISON¹), WATSON) have, of course, all seen the radial fascicles; but as to the examination, and description thereof it is as with their description of the buccinator group: most deficient.

If we survey the whole muscular system of the trunk, we find it contains, *first* longitudinal and oblique fascicles, the latter moreover arranged in two crossing layers. The longitudinal fascicles, *m. maxillo-labialis*, occupy the dorso-lateral circumference; the oblique fascicles, the *pars rimana* and the *pars supralabialis m. buccinatorii*, the ventro-lateral. In this arrangement of the fascicles lies the explanation of the extremely free mobility of the trunk. The longitudinal muscles, »the levatores proboscidis« of previous authors, produce the raising movements of the trunk, the amplitude of which, as is well known, is so great that the trunk may be raised up so as to rest upon the upper surface of the head and the neck. This movement is, in the main, made by the portio superior *m. maxillo-labialis*, whereas a onesided contraction of the portio inferior, which lies chiefly on the lateral face of the trunk, will produce a lateral motion. A simultaneous activity of the oblique muscles, the »depressores proboscidis« of previous authors, will produce either a lowering of the trunk, or, (by simultaneous relaxation of the longitudinal muscles) the well-known rolling up thereof against its ventral face, whereas a onesided contraction will evidently be instrumental in the lateral motion. By a combination of these movements the trunk will be able to adjust itself in all directions. For the sake of comparison we may invite attention, for a moment to the muscles of the tail of Mammals, which it is hardly necessary to remind our readers, is also most freely movable. The muscles of this organ are most familiar in the domestic Mammals, where they are, primarily, arranged longitudinally, both on the dorsal and the ventral faces; and these muscles first produce the raising and depressing movements. The former may be carried so far that the tail is rolled up against its dorsal face²), but these longitudinal fascicles can also, certainly by onesided activity, — eventually supported by the small *mm. intertransversarii* that span from one *proc. transversus* to the next — produce lateral motions. But these are, in the main, due to a pair of *oblique* muscles that, one on each side, extend from the pelvis to the anterior vertebræ of the tail (the *m. coccygeus* of the Veterinarians). The tail then, can execute many of the same movements which we have described in the proboscis: but in the more special arrangement of the muscles there is however an essential difference. The muscular mass, the fleshy mass, is in the tail chiefly gathered round its »root«, i. e. its proximal part; certainly the muscles extend for a considerable distance down the tail (some muscles almost to its very point), but distad the fleshy mass soon greatly decreases. The great range of movement of which the tail is capable, is then produced in such a way that from the muscular mass there arise long thin tendons that run far out on the tail, often passing over several vertebræ before they are inserted. On the proboscis the case is otherwise. The fleshy mass here extends to its very tip, being the chief content of the proboscis, which by its immense contents of fibres, can throw enormous force into its motions.

¹) The paper quoted p. 43.

²) There are, however, also Mammals that can roll up the tail against the ventral face.

Furthermore in the proboscis the whole system of the radial fascicles, the *m. rectus nasi*, is found, and they are certainly of great importance in many respects. It can hardly be doubted that, by their contraction, they will dilate the nasal tubes, so that they can support the *m. lateralis nasi* in its action (v. p. 39), when the animal sucks up water in the trunk. Further it is surely this muscular system which produces the *elongation*¹⁾ of the trunk; the Elephant can *stretch* the trunk. When the rectus system contracts, the skin and the walls of the nasal tubes approach, and when at the same time the other muscles are relaxed, the trunk will by this means be elongated. Finally, there can be no doubt but that the rectus system is of great importance in so far as the activity of the *m. maxillo-labialis* is concerned. And this because contraction of the rectus-fascicles will fix the aponeuroses, from which, as we have already pointed out, the longitudinal fascicles take their origin and into which they are inserted.

Finally we add the following comments: The entrance to the nasal tubes, at the point of the trunk, is, as is well-known, in the Indian Elephant limited dorsad by an elongation shaped like a finger, ventrad by a lip-shaped fold of the skin. »The finger« and »the lip« can be separated, or brought together. In the former motion »the finger« is raised by contraction of the fascicles of the portio superior *m. maxillo-labialis*, while »the lip« is drawn down by the fascicles of the pars rimana, which, just on the distal part of the trunk, take a direction that nearly approaches the longitudinal. The opposite motion, the bringing together of »the finger« and »the lip«, by which the animal can seize objects, is, on the contrary, executed by the portio supralabialis, whose fascicles, on the distal end of the trunk, run so obliquely that they almost approach the transverse direction.

In the cheek of the Elephant we have found a system of fascicles which from the mucous membrane radiate transversally, a »*m. rectus buccæ*«, analogous to the *m. rectus nasi*. From the mucous membrane, partly from both faces of the great fold mentioned (v. p. 35), partly, in front of and behind it, there arises a rather considerable mass of thick fascicles that radiate transversally, some of them in a low bow, thrusting themselves in between the longitudinal fascicles of the *m. buccinatorius*, where they end. Particularly behind the great fold of the mucous membrane these fascicles appear in considerable numbers. In none of the other Mammals examined we have found anything corresponding.

In the *upper lip* with the exception of the proboscis we have found no rectus-bundles. In the *under lip* there are numerous rectus-bundles going from the inner side of the spout-formed anterior part of the under lip to the outer side of the same — the only muscular elements in this part of the under lip. Posteriorly these rectus-bundles close the numerous bundles of the *m. mentalis*, as the anterior continuation of which muscle they appear.

7. MUSCLES OF THE EXTERNAL EAR.

Pl. 1; Pl. 15, fig. 7.

The external ear of the Elephant, with its muscles, is peculiar in that, for the most part, it is situated on the neck, and the muscles to a larger extent than usual take their origin from the neck.

A *scutellum* is not present; but there is a tendinous stripe in the muscular plate formed by a number of the greater ear-muscles, which without doubt is the representative of the lost scutellum.

a. Scutularis-group.

The *m. scutularis* is represented by the following portions.

Above, and close behind, the eye there arises from the skull a short flat muscular belly, No. 1, whose fibres are directed upward and hindward; it is continued by a long narrow, and strong tendon, which slightly arcuate runs above the great facial gland.

¹⁾ Comp. HARRISON, Anatomical Observations of some parts of the Elephant. From Proc. R. Irish Acad. Vol. 3 (1847). p. 12.

A little above this muscular belly lies a rudimentary muscle, No. 2, which also is continued into a tendon, which soon joins that of No. 1. The joint tendon passes behind the facial gland into a powerful muscle, No. 3, whose fibres have a horizontal direction, and which are inserted, fleshy, into the convex side of the auricle near the anterior margin below the anteron 7. With No. 3 is again another considerable muscle connected, No. 4, which arises from the connective tissue outside the *m. temporalis*, and from the skull behind the temporal fossa. The fibres thereof are directed backward and a little downward; inferiorly it passes without any limit into No. 3. The upper part of No. 4 is inserted into a tendinous stripe, the homologue of the *scutellum*, into which also the *m. auriculo-occipitalis* is inserted.

The muscles 1, 2, 3 and 4 together represent the *m. scutularis*; No. 3 is the *pars transiens*. The portions designed as No. 1 and 2 are similar to the detached foremost part of the scutularis in the Tapir (Pl. 7).

M. rotator. From the tendinous stripe mentioned above, and from a line on the inside of the scutularis lying in the continuation of this stripe a short strong muscle, No. 5, arises which is inserted into the convex surface of the auricle near the anterior margin (at the base of the anteron 5), above the insertion of the deep portion of the postauricularis. The direction of the fibres are principally dorso-ventrad.

Although the direction of the fibres of the *m. rotator* is generally more before-backward and the insertion also somewhat more backward, the muscle described cannot be anything but the rotator. The altered direction of its fibres is dependent on the alteration of the place of the whole ear; and the difference in the insertion is insignificant.

b. Auriculo-occipitalis-group.

The *m. auriculo-occipitalis* is split up into two quite distinct portions, which both arise near one another from the fascia covering the large muscles of the neck; they arise rather far from the skull, and from the middle line. The *anterior* (or superior) portion (No. 6), which may again be separated into two halves, lying close to one another, corresponds to that part of the auriculo-occipitalis which in other Mammals is inserted into the scutellum. It is inserted into the tendinous stripe, described above as the homologue of the scutellum. At the insertion, its fascicles cross those of the upper portion of the scutularis. Some of the inferior bundles thereof join the external side of the rotator. — The *posterior* (inferior) portion (No. 7) is a long rather strong, but narrow muscle which arises from the same fascia close below the anterior portion. It is inserted into the mediad side of the auricle near the anterior margin close below the insertion of the *pars transiens musculi scutularis*. It has a broad plane of insertion, while usually the auricular part of the auriculo-occipitalis is inserted into a long transverse line.

The Elephant is not the only Mammal, in which the auricular portion of the auriculo-occipitalis has been quite separated from the rest of the muscle. In the Elk, for instance, the same is the case.

The *m. postauricularis* is represented by *three* quite separated muscles, of which two represent the *superficial*, the third the *deep* portion. Of the two muscles representing the *superficial* portion the *superior* (No. 8) arises on the side of the neck covered by the auricular portion of the auriculo-occipitalis and is inserted into the mediad side of the auricle, close below the insertion of the same auricular portion. The *inferior* (No. 9) arises close below the auricular portion of the auriculo-occipitalis, to which both muscles (No. 8 and 9) are similar in form, and is inserted at a rather great distance from No. 8 close above the hind end of No. 12. — The *deep* portion (No. 10) is a broad rather strong muscle lying on the *m. splenius*, surrounded by a fibrous sheath and adipous tissue; it is inserted into the auricle below the insertion of the rotator near the anteron 5.

The *m. adductor inferior* (No. 11) is a peculiar little short and broad muscle lying in front of the ear-opening. The muscle, which is somewhat fan-shaped, arises for the greater part from

an aponeurosis ensheathing the *m. temporo-auricularis* (No. 13); but the inferior bundles take their origin from the skull close in front of and above the so-called external bony auditory meatus (formed by the squamosal bone and surrounding partly the proximal end of the auricular cartilage). The inferior bundles are horizontal, the superior vertical; the inferior part of the muscle is far the strongest, the superior being rather thin. The insertion is on the distal border of the tragus and on the bridge-like part of the auricle lying between the incisura post. 4 and the incisura ant. 2.

From the hinder end of the zygoma arises a strong rectangular muscle (No. 12), which is inserted into the auricle below the muscle just described, on the mediad side of the auricle unto the margin, which in an ordinary Mammal is the posterior margin of the ear-conch (distal border of incisura post. 4). The insertion quite corresponds to that of the *auricular portion of the m. sphincter profundus*. Against this homologization stands the direction of the fibres, which is horizontal, and the fact, that they take their origin from the zygoma. But the altered direction of the fibres may be a consequence of the *lorsion* of the whole ear. And as to the origin of the muscle from the zygoma it must be remembered that other facial muscles may also sometimes take their origin from the connective tissue or from other muscles, sometimes from the skeleton. And as to the sphincter profundus especially we have seen that it may arise from the anterior end of the sternum (c. g. *Myopotamus*, p. 8). So far there is nothing which could make it impossible to accept that interpretation.

The only other possibility is that it is a muscle comparable to the *»adductor externus»* of the Horse, which muscle we have interpreted as a separate portion of the adductor inferior. But this muscle is a development peculiar to the Horse, and not present in other Mammals examined by us. And it appears not very probable that the muscle in question, in the Elephant, should also be a separate part of the adductor inferior. But it is possible, and the question as to the homology of the muscle is still an open one.

c. *Musculus temporo-auricularis* (No. 13).

This muscle takes its origin from the skull close above the external bony auditory meatus. In comparison with the same muscle in most other Mammals it is a rather short, and stout, muscle. It is inserted, as usual, into the anteron 5. The muscle

is in the Elephant situated as in the Dog on the front side of the cartilaginous meatus, while for instance in the Horse it has its place more posteriorly. In the Elephant it is situated nearer to the outer surface than in other Mammals, so that it is partly visible as soon as the skin is removed; in other Mammals it lies deeper.

d. Muscles which both arise from and are inserted into the auricular cartilage.

The *m. anteri sexti* (No. 14) has its place directly behind the adductor inferior, with whose superior fascicles it is intimately connected. It arises (as in the Horse etc.) from the tragus and does not as in most other Mammals reach the anteron 7 but is inserted into the outer side of the hooked anteron 6 (comp. the Horse, p. 19). It is a rather strong, slender muscle.

The *m. transversus* (No. 15) has, as usual, its place on the mediad side of the auricle; it is comparatively strong. Most of its fibres have a direction toward the apex of the ear; the fibres of a smaller anterior portion (No. 15*) are directed toward the superior (anterior) margin of the ear.

Note. Finally we note a little rather singular muscle, which we have found in the Elephant examined: *Musculus x*, Plate 2.

After removal of the auricle and its muscles we found on the upper part of the right side of the head, directly behind the temporal fossa, a triangular pennate muscle, thin and flat. The muscular body, which is 5 cm broad, 7 cm long, is at the top continued into a narrow tendon, which has a dorsal direction and ends in the periost behind the temporal fossa. The muscular fascicles radiate downwards and end in the connective tissue. The muscle lies on a considerable layer of adipose tissue, a couple of cm thick, lying outside the skull between the origin of the *m. temporalis* and the insertion of the *m. splenius*.

This remarkable muscle was only present on the right side of the head; on the left side there was no trace of it; we note especially, that on the right side it was so distinct and conspicuous, that there is no possibility of our having overseen it on the left side, if it had been present there. How this muscle shall be interpreted, how it has arisen, and what are its functions, we are at a loss to say. It has no connection whatever with the ear-muscles, nor with any of the other muscles, nor have we in other Mammals found a muscle comparable with it.

C.

THE PROBOSCIS.

The right and the left upper lips of the *Dog*, towards their anterior ends, become lower and, in the middle line, before the incisors, — where they unite, — form a thick vertical fold (Pl. 17, fig. 5), the mucous side of which is a somewhat oblique plane, separated from the hard palate, first by a low gingiva and then by the incisors. The outer face of the median part of the upper lips has a vertical direction; dorsad it is continued into that part of the skin which surrounds the nostrils and which is partially lying in the same plane. The nostrils are round openings directed forwards and continued by a slit laterally. The skin surrounding the nostrils is hairless and areolated; only below the slit mentioned the skin is hairy. The outer face also of the median part of the upper lip is hairy; only a narrow median furrow running from between the nostrils unto the margin of the lip is bare. On the inside of the lip there is no median furrow, but a median projecting fold (frenulum).

The said median part of the upper lip, and the region lying above it, surrounding the nostrils, is the *snout* proper. Into it extends the anterior part of the cartilaginous nose.

The extent of the *hairless portion* of the skin of the snout is exceedingly different in various Mammals. Sometimes it extends farther than in the *Dog*; e. g. in *Procyon lotor* the lower margin of the slitlike portion of the nostrils also is bare; sometimes the upper lip, below the nares, is endowed with only a very few hairs (*Tragul* etc.). In others the case is quite contrary: the hairless parts being reduced; e. g. in the *Goat* and the *Horse* the nostrils are entirely surrounded with hairy skin, which extends also into the anterior part of the nasal cavities; only the median furrow on the upper lip is still bare in the *Goat*. Other forms, e. g. the *Red deer*, take up an intermediate position.

The median furrow on the upper lip is not always present; it may be quite levelled. But it may also be continued on the mucous side of the lip (*Lemur*, *Red deer*). And the furrow may be so deep, that the upper lip in the median line is separated into two halves, as is the case in many Rodents.

In Mammals in which the median incisors are wanting, the mucous side of the median portion of the upper lip may be a direct continuation of the hard palate, the perpendicular or oblique direction of this side of the lip being modified into a horizontal. Such is the case in *Tragulus* (Pl. 17, fig. 9) and *Lemur*.

Another alteration in the relative position of the various sections of the surface of the region in question is found in *Man* (Pl. 17, fig. 12). Here the direction of the mucous and external side of the median portion of the upper lip is the same as in the *Dog* and most other Mammals. But the area surrounding the nostrils has altered its position from a vertical into a horizontal one, meeting

in an angle the outer face of the upper lip, which in the *Dog*, and others, lies in the continuation thereof.

In the Mammals (Pl. 17, fig. 7, 10 etc.), in which the snout is elongated into a longer or shorter *proboscis* projecting beyond the lower lip: several Insectivora, *Sus*, *Nasua* etc. (the *Tapir* and the *Elephant* we for the present set aside), it is *the dorsal part* of the snout, unto the area round the nostrils, which in the first place has become elongated. The *area* round the nostrils has not generally been substantially altered, and has retained its original vertical position on the end of the snout. The *margin* of the lip has retained its original position, and the *outer face* of the median portion of the upper lip has therefore, as a sequence of the prolongation of the dorsal side of the snout, been forced to change its vertical position into a horizontal one. The ventral side of the proboscis is thus the homologue of the outer face of the median part of the upper lip lying between the margin of the lip and the area round the nostrils. With this area it is connected by an angle, which is inverse to the angle between these two sections of the surface in *Man* (comp. fig. 7 and 12, Pl. 17). — The *Badger* (Pl. 17, fig. 6) forms an interesting connecting link between an ordinary Mammal, as the *Dog*, and Mammals with a proboscis, the outer face of the median portion of the upper lip in the *Badger* being *not* vertical as in the *Dog*, *nor* horizontal as in the probosciferous, but *oblique*.

As to the *mucous side* of the median portion of the upper lip. It has, in Mammals with a proboscis, sometimes remained as in the *Dog*. Such is the case in *Nasua* (fig. 7), and also in *Myogale* and *Talpa* (fig. 10), in which latter the margin of the lip projects as a low thin brim on the border of the outer and the inner face of the upper lip; also in the *Swine* the same is the case. In others the mucous side of the lip has also taken a horizontal position, lying in the direct continuation of the outer side of the lip (*viz.* the lower side of the proboscis) and being also posteriorly directly continued into the hard palate, there being in the same forms a toothless space in front. Such is the case in *Erinaceus*, *Macroscelides* (fig. 8) and *Centetes*.

The *median furrow*, which in the *Dog* and others is present on the outer — and sometimes also on the mucous — face of the upper lip, may also be present in the corresponding place in probosciferous Mammals. It is very marked in *Erinaceus*, where it is continued into the hard palate and is laterally bounded by a bare raised border. In *Macroscelides* the furrow is very deep, growing broader proximad and being continued unto the mouth. In *Centetes*, whose proboscis is very short, the furrow is continued on the mucous side of the lip (which is in *Centetes* sharply

defined from the outer side); it divides the frenulum longitudinally. Also in *Talpa* there is on the ventral side of the proboscis a distinct naked furrow, which posteriorly widens out.

The proboscides of the *Tapir*, and of the *Elephant*, are *externally*, on the whole, formed as in the other Mammals with a proboscis. In the *Tapir* (Pl. 17, fig. 13) the nostrils situated at the end of the proboscis are surrounded by a naked area, from which proceeds a longitudinal naked stripe on the ventral side of the proboscis, which stripe — the longitudinal furrow of other probosciferous Mammals — grows broader posteriorly and is continued without sharp demarcation by the mucous side of the upper lip, which has an oblique direction. The said mucous side is *not* directly continued into the hard palate. As in the Dog etc. there is a gingiva and incisors between both.

In the *Elephant* (Pl. 17, fig. 14) the area round the nostrils is hairy as in many other Mammals. The furrow on the ventral side of the proboscis is most distinct and narrowest near the distal end, where it is also naked as usual; proximad it becomes less sharply defined and hairy. At the proximal end the under side of the proboscis is continued directly into the mouth; the hairy surface is continued unto the margin of the intermaxillary bone, and the mucous side of the lip has totally disappeared.

But though the proboscis of the Elephant, as well as that of the Tapir, in its outer appearance is not substantially different from that of other Mammals, the case is quite otherwise in so far as the *inner constitution* of the proboscis is concerned. In all the probosciferous Mammals examined, exc. the Tapir and Elephant, we find that the *nasal cartilage* is continued unto the apex throughout the whole proboscis. In *Sus* the nasal cartilage is almost immovably connected with the skull, and only the skin on the apex of the proboscis is movable, through the action of the m. maxillo-labialis, whose tendons end in it. In *Talpa* and *Macroscelides* we have found the nasal cartilage partially calcified, and the mobility of the proboscis is therefore certainly not very extensive in these animals. In *Nasua* the nasal cartilage is movably connected with the skull and the mobility probably somewhat greater. But on the whole the mobility of the proboscis in the probosciferous Mammals, exc. the Tapir and the Elephant, is rather limited. In all those Mammals (Pl. 14, fig. 1) the proboscis is principally constituted by the nasal cartilage and the skin, between which run the tendons of the m. maxillo-labialis, numerous nerves (branches of trigeminus) etc.; while muscular tissue is very scarce (parts of m. nasalis etc. may be found in the proboscis).

In the *Elephant* and *Tapir* the *nasal cartilage* does *not* extend into the proboscis; only the posterior end thereof, hard on the nasal bones, is present, and the proboscis is composed only of epithelium, connective tissue and muscles (and of nerves, vessels and — in the Tapir — of glands): Pl. 14, fig. 2—3. The flexibility of the trunk has in this manner been greatly augmented, and such an instrument could then be developed, as the trunk of the Elephant, which is able to be moved in all directions with the greatest ease, to be spirally rolled up, to be shortened and lengthened etc.

And in this flexible proboscis of the Elephant and the Tapir the *muscles* have been evolved in a manner quite different from what is found in other probosciferous Mammals. In all save the Elephant and the Tapir the general arrangement is such, that a number of thin tendons belonging to the m. maxillo-labialis go to the end of the trunk; between them, project the branches of the m. nasalis. In the *Elephant*, which we will first take into consideration, the m. maxillo-labialis still plays an important part in the movements of the trunk, but it is wholly fleshy and extends as a fleshy mass divided into numerous bundles throughout the whole length of the trunk to its distal end. And other muscles participate in the formation of the muscular system of the trunk: the pars rimana and the pars supralabialis m. buccinatorii and the numerous mm. recti going between the mucous membrane of the nasal tubes and the skin. In this manner the whole proboscis of the Elephant is in the main a *fleshy* mass, the constitution of which may be compared with such an organ as the tongue of the Mammals: while the proboscis of most other Mammals is mainly composed of cartilage and connective tissue in various forms (tendons etc.).

Thus the proboscis of the Elephant has become a *prehensile* organ. For such is the biological meaning of all this: in other Mammals with a proboscis (exc. the Tapir) this organ is *tactile* in function, sometimes also an organ which may be used to root about in loose material; but not a prehensile organ at all; while in the Elephant, the faculty of serving as a tactile organ being retained, the prehensile functions have taken the first place and have reached a state of high perfection. The final touch, so to speak, in perfecting the proboscis of the Elephant we find in the well-known particularity of the end thereof, which is peculiar in that the septum between the nasal tubes stops short, a little before the end of the proboscis, the distal ends of the nasal tubes being here for a short distance confluent. At the end of the proboscis thus there is only *one* hole, surrounded by a liplike border, whose ventral and dorsal regions — the last with the well-known short prolongation — may be moved against each other, the end of the proboscis thus being enabled to grasp small objects. But other parts of the proboscis have also an extraordinary faculty for prehension.

The proboscis of the *Tapir*, because of its shortness, cannot perform such feats as that of the Elephant can accomplish; but it is developed on similar lines. It is a highly muscular body, in which the muscular tissue, represented by numerous mm. recti, the m. maxillo-labialis, nasolabialis and pars rimana, contributes a considerable portion of the whole mass, without having, however, such a share in the composition of the trunk as in the Elephant, a considerable part of the place within the wall of the proboscis being filled with glands opening into the nasal tubes, or into the mouth. It may also be noted, that the muscles of the proboscis are in this animal of a far less complicated structure, have to a much slighter degree been differentiated, than in the Elephant. But the proboscis in the Tapir is also a grasping, prehensile organ.

APPENDIX:

Descriptions of the facial muscles of various Ungulates.¹⁾

1. CAMEL.

(*Camelus bactrianus*, young. — *Dromedary*.)

1. Platysma-sphincter-group.

Pl. 5.

The *sphincter superficialis* is wanting, at all events on the head²⁾.

The *platysma* forms a flat, continuous, rather full muscular body, the bundles of which arise from an aponeurosis on the dorso-lateral circumference of the neck and the occiput. The bundles extend farther back (a little behind the parotis) in the Camel than in the Dromedary (v. Pl. 5), in which they arise at some distance in front of the salivary gland. The muscular body stretches with longitudinal, slightly arched bundles on the lower part of the face, reaching nearly half way up on the masseter, the anterior end thrusting between the bundles of the m. buccinatorius, at some distance behind, and below, the angle of the mouth. In the Camel they do not extend quite so far as in the Dromedary, where the anterior bundles pass obliquely upwards, towards the lower lip. The muscular body is so broad that it extends downwards, round the margin of the lower jaw, from which several of the lower bundles take their origin. Upwards the muscular body is continued in the form of a thin fascia, which covers a great part of the m. masseter and the other muscles of the face (in Pl. 5 this fascia has been dissected off).

The *pars zygomatica* is completely separated from the rest of the platysma. It is a broad and rather powerful muscle arising with a flat well defined tendon from the arcus zygomaticus: from the origin the bundles turn forwards in a slight arc, then passing longitudinally straight forwards in the direction of the angle of the mouth, thrusting, at some distance behind the latter, between the bundles of the m. buccinatorius.

The *sphincter profundus* is present in the shape of two portions quite separated from each other. The posterior, the *auricular portion*, arises with a thin aponeurosis, outside the parotis; the narrow, very thin and pale muscle inserts itself into the lateral circumference of the basis of the auricle. The anterior portion, the *portio palpebralis*, arises with a thin aponeurosis outside the m. masseter and the m. buccinatorius, which is covered by the platysma. The muscular body is flat, thin and rather narrow, and its bundles converge dorsad thrusting between the bundles of the m. orbicularis oculi of the lower eyelid.

¹⁾ The muscles of the external ear have not been included in these descriptions, which on the whole make no claim of being exhaustive, but which we think will nevertheless be of some use. They have been prepared for the sake of comparison with the corresponding muscles of the Elephant.

²⁾ Nor in the *Lama*, the whole neck of which we have examined, there is a sphincter superficialis present. The neck of the Camel we have not had an opportunity to examine.

2. Orbicularis-oculi-group

(Pl. 5 and Pl. 16, fig. 21)

is quite primitive in so far as the whole group forms a *continuous muscular plate* in which no single muscle can be separated.

Round the eye is the *m. orbicularis oculi*, which consists partly of circular fascicles, partly of fascicles that cross one another behind the posterior angle of the eye (comp. the diagram Pl. 16, fig. 21). The whole muscular mass is so broad that it projects not a little beyond the margin of the bony orbita. It is particularly broad in the lower eyelid — rather broader than in the upper one — so that the fascicles which turn in an arc up behind the posterior angle of the eye extend a considerable distance behind this.

Posteriorly the orbicularis passes immediately into the *m. postorbicularis*. In the young Camel which we examined, the fascicles ran in a low arc dorso-ventrad, closely joining the orbicular fascicles. In the Dromedary figured, Pl. 5 and Pl. 16, these postorbicular fascicles are shorter, extending downwards only along the orbicular fascicles of the upper eyelid, and interlocking with the orbicular fascicles of the lower eyelid.

Anteriorly the orbicularis is continued directly in the *m. præorbicularis*, which consists of fascicles that run in an arc from the forehead downwards before the m. orbicularis, the curve corresponding so exactly to that of the fascicles of this muscle that no limit whatever can be found between them. The præorbicular fascicles spread like a fan downwards, thrusting themselves for the most part between the fascicles of the m. buccinatorius. Above the eye the præorbicular fascicles are continued posteriorly into a rather broad and flat muscular body, the *m. supraorbicularis*. The fascicles of this muscle arise from an aponeurosis on the frontal surface, run outwards, and a little forwards, and extend downwards into the upper eyelid.

In front, the m. præorbicularis passes immediately into the *m. nasolabialis*, which forms a long and high, flat, muscular body extending over the anterior part of the face. The fascicles, which arise from an aponeurosis in the fronto-nasal region, run obliquely forwards and downwards. Behind the angle of the mouth they thrust themselves between the fascicles of the superficial layer of the m. buccinatorius; whereas in front of this they run into the upper lip. The origin of this muscle extends over the whole dorsum of the nose and, in the anterior part, the fascicles gradually take a more and more transverse direction, so that they at last run transversely outwards to the dorsal circumference of the nostril. A little behind this the muscular body is pierced by a bundle of fibres from the m. maxillo-labialis, which runs longitudinally above the nostril. (Pl. 5, comp. Pl. 11, fig. 4.)

3. *M. maxillo-labialis*.

Pl. 11, fig. 4.

Of the *m. maxillo-labialis* only the *portio inferior* is developed. This arises tendinously from the maxillary bone, ventrad and partially laterad of the foramen infraorbitale. The muscular body is flat, radiating like a fan forwards and upwards; the posterior rather short fascicles run upwards, inserting themselves into a thin aponeurosis, which inside the *m. nasolabialis* spreads out upon the nasal surface. The next fascicles radiate towards the nostril, inserting themselves along the posterior and lateral circumference, the inferior ones running into the upper lip. The muscle is covered by the *m. nasolabialis*, but a little behind the nostril the latter is pierced by a portion of maxillo-labialis-fascicles which proceed along the mediad margin of the nostril.

4. Buccinator-group.

Pl. 5, 6; Pl. 11, fig. 4; Pl. 16, fig. 1 and 2.

The *m. buccinatorius* consists of two layers. The *superficial* layer (Pl. 5; Pl. 16, fig. 1), which is rather powerful, especially anteriorly, extends posteriorly to the *m. masseter*; and consists of arched, transverse fascicles that stretch from the upper to the lower jaw, turning round the angle where the cheek and the gingiva meet. Posteriorly, in the region in front of the *m. masseter*, the *gl. buccales inf.* form a large, extended, continuous glandular mass, mostly covered by the transverse bundles of the buccinator. In front, towards the angle of the mouth, the layer becomes more powerful and passes direct into the *pars rimana*. In the upper lip the latter forms a rather narrow muscular brim along the margin of the lip, whereas, in the under lip, it is considerably higher, the bundles being disposed here in the following way: Along the margin of the lip a considerable number of bundles proceed parallel thereto; the inferior bundles, however, go obliquely forwards and downwards, passing in an arc inside the gingiva, inserting themselves into the lower jaw somewhat below the alveolar margin (Pl. 16, fig. 1.) A rather considerable layer of the *gl. labiales inf.* is covered by the superficial layer of the buccinator (Pl. 6). The following yet remain to be described: Closely behind the angle of the mouth, in the region between the bundles, that turn forwards to form the *pars rimana*, and the entrance of the *pars zygomatica*, there are a number of the most superficial bundles which behave in a peculiar manner; these bundles proceed straight upwards, partly spreading somewhat fan-wise and inserting themselves rather high upon the maxillary bone, almost up to the nasal bone (v. Pl. 5, where these bundles are distinctly seen thrusting up under the *m. nasolabialis*; comp. Pl. 16, fig. 1).

Covered by the superficial transverse layer there is a *deep longitudinal layer* (Pl. 6; Pl. 16, fig. 2). This layer stretches along the whole row of teeth so that the posterior part thereof has its place within the *m. masseter*. It arises from the posterior part of the maxillary bone (*tuber maxillæ*), from the mucous membrane, and from the anterior margin of the *ramus ascendens mandibulæ*, at first forming a thick continuous layer, the bundles of which stretch longitudinally forwards. On their way several of these bundles insert themselves into the mucous membrane, partly thrusting between the pretty numerous but rather small *gl. buccales*, which are spread over most of the mucous membrane (v. Pl. 6; numerous pits are seen on the outside of the mucous membrane, in which these glands have had their place). At first the bundles pass longitudinally, straight on, but as they approach the angle of the mouth, they turn obliquely upwards in the direction of the angle of the mouth and the upper lip, so that none of the bundles of this layer reach into the under lip (Pl. 16, fig. 2). The lower bundles insert themselves into the mucous membrane just behind the angle of the mouth, whereas the others take the following course: The upper bundles (*a*, Pl. 6; comp. Pl. 16, fig. 2) run upwards in a body, and insert themselves into the maxillary and the intermaxillary bones, mostly covered by the bundles of the superficial layer mentioned above. The other

bundles (*b*, Pl. 6) however, proceed obliquely into the upper lip, turn round the angle where the upper lip and the gingiva meet, and are inserted into the intermaxillary bone just above the alveolar margin. As a direct continuation of these bundles there is in the rest of the upper lip (the anterior portion of the lip) a continuous layer of bundles going from the margin of the upper lip in an arc round the angle where the mucous membrane of the upper lip and the gingiva unite, and inserting, farther on, into the intermaxillary bone (Pl. 16, fig. 2). Here we have the *pars supralabialis m. buccinatorii*.

In the upper lip there are numerous small *gl. labiales sup.* placed between the fascicles.

The *m. nasalis* (Pl. 6) arises from the intermaxillary bone in the space from the median line unto near the canine, close above the insertion of the *portio supralabialis m. buccinatorii*. The bundles radiate from here upwards, the mediad ones turning in a bow up to the portion below the nostril where they insert themselves; the lateral ones spreading up to the lateral and posterior circumference of the nostril. On Pl. 6 these bundles are seen stepping out above the *portio supralabialis*.

The *m. mentalis* forms a thin muscular brim which arises from the anterior part of the lower jaw just below the insertion of the *m. buccinatorius* and radiates with its bundles downwards to the skin of the under lip. On Plate 5 and 6 these bundles are seen stepping out below the *pars rimana*.

5. *M. rectus nasi* and *m. rectus labii*.

In the »soft nasal tube« there are fascicles which extend from the skin of the exterior face of the nasal tube to the skin of the interior face of the nasal tube; and in the lips there are bundles going from the skin to the mucous membrane. We have limited ourselves to a microscopical statement of the presence of these bundles, but can say nothing further of their number and other facts.

2. ELK.

(♂ junior — ♀ senior.)

1. Platysma-sphincter-group.

The *sphincter superficialis* is wanting, at all events on the head.

The *platysma* forms a continuous, flat, narrow, but rather powerful muscular body, coming from the neck and the occiput and running almost straight forwards. The bundles are longitudinal, almost parallel to the longitudinal axis of the head and only bend slightly upwards in the anterior part. The muscle goes across the angle of the mandible, covering the lower part of the masseter and the buccinator, and making for the angle of the mouth and the under lip. 4—5 cm behind the angle of the mouth it meets with the *pars zygomatica*, which with its lower bundles also makes for the angle of the mouth, and in a space of about a couple of cm behind the latter the two muscles unite so closely that a limit between them cannot be shown. The platysma bundles end partly at the angle of the mouth partly in the under lip, where they thrust between the bundles of the *pars rimana m. buccinatorii*.

Dorsad the muscular body of the platysma passes into a thin aponeurosis that covers the other muscles of the face. In this aponeurosis there are posteriorly imbedded some scattered muscular fascicles, radiating forwards and upwards, especially in the part covering the parotis and the masseter.

The *pars zygomatica* arises independently from the zygoma with a thin but rather broad aponeurosis, outside the masseter. About the anterior margin of this muscle it passes into a narrow but rather powerful muscular body that goes a little obliquely forwards, and downwards, towards the upper lip and the angle of the mouth. As already mentioned, it joins the platysma a little behind the latter. The upper bundles proceed into the upper lip where they mingle with the bundles of the *pars rimana*.

The *sphincter profundus* consists of two portions quite sepa-

rated from each other; the anterior one, the *palpebral portion*, is somewhat longer, narrower, but more powerful than in the Camel; for the rest, it behaves in the main as in the latter. The posterior part, the *auricular portion*, however, is of particular interest, being present in the shape of a real »sphincter«. From the lateral face of the base of one auricle there arises a muscular body, narrow but rather powerful, which passing down outside the parotis, and, turning on to the ventral face of the upper part of the neck finally joins its fellow on the opposite side of the head (Pl. 15, fig. 6). Only the anterior bundles of this sphincter profundus go sphincterlike from one auricle to the other; but the posterior bundles, from each side, radiate upon the ventral face of the neck and are here interlaced in the median line. Thus the part of the sphincter profundus that lies on the ventral face of the neck forms a triangular flat muscular body, the point of which is directed backwards and reaches posteriorly to about below the middle of the epistropheus.

2. Orbicularis-oculi-group.

Pl. 16, fig. 22.

The *m. orbicularis oculi* consists of circular bundles arising from, and inserting themselves into, a strong and distinctly marked ligamentum palpebrale nasale. Besides, there are bundles, arising from the ligamentum palpebrale nas., going in an arc into the lower eyelid and turning up, behind the posterior angle of the eye, where they spread like a fan and reach rather far up (in a young male they extended up to the very base of the pedicle of the antler). The whole orbicularis is so broad that it projects beyond the bony orbital margin. At the posterior angle of the eye there is a small, narrow, flat *m. horizontalis*, arising a little behind the angle of the eye, partly outside partly between the orbicularis bundles, running straight backwards and inserting itself into the connective tissue a little in front of the ear; it covers the orbicularis bundles that turn up behind the posterior angle of the eye.

The *m. præorbicularis* is strongly developed, large, and as it were, dividing into two portions. *One portion* consists, as usual, of bundles arising from the lig. palpebrale, in front of and in continuation of the orbicularis, and radiating fan-wise dorsad and ventrad, the posterior ones quite intimately joining the orbicularis-bundles (Pl. 16, fig. 22, *prd* and *prv*₂). As an immediate continuation of the upwards radiating bundles there is a row of fascicles radiating from the front obliquely outward and projecting into the upper eyelid, almost in its whole length: the *m. supraorbicularis* (the *m. corrugator supercilii* of the Veterinarians). Together they form a rather broad muscular plate, which in the ♂ investigated reached backwards to the pedicle of the antler. — The *other portion* of the præorbicularis (the *m. malaris* of the Veterinary anatomy; Pl. 16, fig. 22, *prv*₁) forms a rather large flat muscular body, arising from the lachrymal bone, the line of origin being approximately a continuation of the lig. palpebrale, turning however anteriorly somewhat downwards. From this line of origin the bundles radiate like a fan downwards and vanish outside the buccinator. The muscle forms a continuation of the downwards radiating bundles of the first-named portion of *m. præorbicularis*; only the dorsal ends of the posterior bundles of *prv*₁ are — on account of their direction obliquely downwards and backwards — covered by some of the bundles of the portion *prv*₂. The lower part of the »*m. malaris*« is covered by the *pars zygomatica platysmatis*.

The *m. nasolabialis* at its origin meets the *m. præorbicularis*, partly invading the bundles of the latter but still appearing in the shape of a muscle distinctly limited from the rest of the orbicularis-complex. From the ligamentum palpebrale the line of origin extends upon the frontal, and it is just on this space that the *m. nasolabialis* stands out partly under, partly between the bundles of the *m. præorbicularis dorsalis*. The line of origin farther proceeds on the nasal surface, that is, on the nasal bones, the cartilaginous nasal septum and between the nostrils. Thus the muscle spans a rather considerable space, forming a large, long, and

flat but rather thin body, which spreads over the very much elongated facial portion of the skull. The posterior bundles pass very much obliquely downwards and forwards, but towards the anterior end of the muscle the bundles, more and more, take a transverse direction; besides, the right and the left muscular body in about the whole length of the *dorsum nasi* are amalgamated, so that across the greater part of the face there is, as it were, a muscular mantle, the transverse bundles of which turn from one side of the face, over the nasal ridge, on to the other side (vide Pl. 11, fig. 1, where however only the anterior part of the muscular mantle is figured). At some distance behind the nostril, and rather far up, the muscle is pierced by the tendon of the superior part of the *m. maxillo-labialis*. The bundles from the larger, posterior, portion of the *m. nasolabialis* (that is, the portion behind the piercing of the superior part of the *m. maxillo-labialis*) insert themselves partly into the connective tissue outside the other facial muscles, partly into the upper lip, whereas the anterior bundles partly insert themselves along the upper margin of the nostril and partly turn behind the nostril to its lower circumference; a number of these anterior bundles insert themselves into the tendon of the *portio sup. musculi maxillo-labialis* (v. Pl. 11, fig. 1). In the portion behind the nostril numerous bundles of the *m. nasalis* cross up between the *nasolabialis* bundles.

3. M. maxillo-labialis

(Pl. 11, fig. 1)

arises fleshy from the maxillary bone below and behind the foramen infraorbitale. A little below the middle there is in the proximal part of the muscle a short tendinous line indicating, as it were, a division of the muscular body into two portions; in reality one finds, in the Elk, that the maxillo-labialis is separated into two distinct muscles which, indeed, at their origin are still quite closely united.

The powerful, rather thick, muscular body of the *upper portion* passes, somewhat rapidly, into a tendon that goes obliquely forwards, and upwards, dividing into a number of »tendinous fingers« that radiate like a fan towards the *dorsum nasi* and the muzzle; as to the insertion of a portion of the nasolabialis into the tendon see above.

The *lower portion* goes forwards. The muscular body soon divides into three portions; each of these passes into a thin tendon which again divides into several tendinous branches. The two upper tendons insert themselves behind the nostril, whereas the lowest proceeds into the upper lip where it may be followed nearly as far as the median line.

Numerous bundles of the *m. nasalis* thrust out between the portions of the *m. maxillo-labialis*.

4. Buccinator-group.

Pl. 16, fig. 3 and 4.

The *m. buccinatorius* in front of the *m. masseter* consists of two well separated layers, a superficial one with perpendicular (transverse) bundles and a deep one with longitudinal bundles. But at the origin, posteriorly, from the upper jaw, and from the anterior margin of the *ramus ascendens* of the lower jaw, the bundles of the two layers merge so smoothly together that one can here only speak of one layer. The lower bundles have, from their origin, a longitudinal direction, but as the line of origin proceeds upon the upper jaw the following bundles take a steeper and steeper direction; and it is only in front of the anterior border of the *m. masseter* that the stratification of the *m. buccinatorius* begins, the longitudinal bundles thrusting below the perpendicular ones.

The superficial layer (Pl. 16, fig. 3) proceeds direct into the *pars rimana* and behaves in the under lip in a way similar to that of the Camel (comp. Pl. 11, fig. 1, where the *pars rimana* is figured in the upper lip).

Along the lower margin of the superficial layer a streak of longitudinal bundles extends: the *m. depressor labii inferioris* of

the Veterinarians, radiating into the chin. It begins about the middle of the cheek and is here, by a small, tendinous, lamelliform portion, closely connected with the perpendicular bundles of the superficial layer, which at first are rather sharply distinguished from the depressor, but on approaching the angle of the mouth the lower ends of several of these bundles turn forwards joining the longitudinal bundles of the depressor so closely that they can by no means be separated from them in the region of the lower lip.

The deep layer of the *m. buccinatorius* (Pl. 16, fig. 4) forms a not very broad band of longitudinal bundles which proceeds on the mucous membrane of the cheek in the direction of the angle of the mouth; numerous small gl. buccales are imbedded between the bundles. The lower bundles insert themselves at the angle of the mouth, where they partly thrust between the bundles of the *pars rimana*. The upper ones proceed into the upper lip forming here the *pars supralabialis*, at first behaving, in the main, as in the Camel: the fascicles run obliquely forward into the upper lip, turn round the angle, where the upper lip and the gingiva meet, and are inserted into the intermaxillary bone; but they form a much lower arc, the gingiva not extending so far upwards as in the Camel. Further forwards in the upper lip, the fascicles successively take a transverse direction, and at the foremost end of the intermaxillary bone the *pars supralabialis* presents a quite remarkable development. From the anterior end of the intermaxillary bone a dense and thick mass of fibres arise which radiate partially to the ventral, partially to the mediad side of the nostril; they do not extend into the upper lip. In a young male specimen this anterior portion of the *pars supralabialis* was continued a little way forward, beyond the intermaxillary bone, that is to say: a portion of the *pars supralabialis* is here found, which does not take its origin from the bone; in this portion the fascicles are seen going from the ventral side of the nostril to the middle line, where, in a raphe-like stripe, they cross those of the opposite side.

The *m. nasalis* (Pl. 11, fig. 1) forms a rather considerable muscular mass radiating upon the lateral surface of the face behind the arched portion of the soft nose. The bundles arise from the intermaxillary and maxillary bones, in rows. The undermost row arises just above the gingiva in about the region from the hindmost corner of the nostril to p_2 , while the following rows gradually arise from the bones higher and higher up. The bundles are of about equal length in each row, but increase somewhat in length in the upper rows, so that there is produced a tolerably regular, tiled arrangement (v. Pl. 11, fig. 1). The undermost rows are separated from one another by the tendinous branches of the *m. maxillo-labialis* and the uppermost are traversed by numerous rectus-bundles.

The *m. mentalis* is quite a powerful muscle arising from the lower jaw. Its anterior end is almost below i_3 . The arrangement of the bundles is, in the main, as in the *m. nasalis*: they arise in rows, one below the other, and radiate down into the chin and the under lip, where they thrust between the *rimana*-bundles.

5. *M. lateralis nasi*

consists of a couple of groups of rather scattered fascicles (v. Pl. 11, fig. 1). There is a posterior group arising from the upper end of the intermaxillary and the neighbouring part of the maxillary bone, radiating with its bundles forwards, and upwards, and inserting itself outside the mucous membrane of the nose. An upper group arises from the upper margin of the nasal cartilage, extending down upon the mucous membrane of the nose.

Further, we have found some fascicles intimately attached to the cartilaginous nose.

Below and behind the nostril there is an irregular, anchor-shaped cartilage. From the exterior, and interior face of this, there arises a flat border of fascicles radiating upwards, partly to the skin, partly to the mucous membrane. Judging from the direction of the bundles, it almost appears as though it was a portion of the *m. rectus nasi*.

Finally, there is a rather powerful fascicle arising from the cartilaginous nose, going forwards, and inserting itself into the lower and lateral face of the anchor-shaped cartilage.

6. *M. rectus nasi*

forms a system of closely packed, and rather thin fascicles from the mucous membrane of the nose to the skin. They occupy the space of the soft nose behind the nostril, where they, especially in the arched portion, form a thick mass of bundles which cross out between the *nasolabialis*-fascicles (Pl. 11, fig. 1).

3. WAPITI.

1. *Platysma-sphincter-group.*

The *sphincter superficialis* is wanting on the head.

The *platysma* is present in a particularly well developed form, viz. as a large continuous muscular plate, which on the ventral face of the head (the regio submandibularis) reaches so far towards the median line that the posterior part is only separated from the corresponding part of the other side by a quite narrow tendinous line, whereas they unite completely in front. The *platysma* covers a very great part of the lateral surface of the face, e. g. the whole masseter, and reaches here up below the ear, so that the bundles in front of this radiate upwards, above the zygoma. Farther on upon the face, bundles reach up to — some partly a little above — the lower margin of the *pars zygomatica platysmatis*. Some bundles thrust into the buccinator, but most extend to the very angle of the mouth, and into the under lip.

The *pars zygomatica* is quite separated from the rest of the *platysma*, and arises with a long narrow tendon from the zygoma. The muscular body is rather broad, but short, and making for the angle of the mouth, where the lower bundles end thrusting between the *rimana*-bundles, whereas the upper ones proceed into the upper lip.

The *sphincter profundus* consists of the same two separated portions as in the Elk. The *auricular portion* may be divided into an upper and a lower part. The *lower part* forms quite a considerable muscular plate on the anterior part of the ventral face of the neck¹⁾. Real sphincter-shaped bundles we could not make out. In the median line the bundles from the two sides are interlaced and pass thence obliquely forward and upward, turning on to the lateral face of the neck; the anterior bundles reach so far on that they turn up in an arc round the angle of the lower jaw; reaching some distance across the lower part of the masseter. The *upper part* of the auricular portion is rather narrow; it extends from the base of the auricle down across the parotis spreading like a fan; some of the anterior and posterior bundles proceed direct in the bundles of the lower part described above, while other bundles terminate about level with the angle of the lower jaw; but are connected with the lower part by a thin aponeurosis. — The *palpebral portion* is powerfully developed; it forms a large, broad, flat, muscular body which arises from the lower eyelid and from the skin in the lower circumference of the lachrymal groove. From here the muscular body stretches downward over the masseter, and the buccinator, passing into a thin aponeurosis that is connected with the lower part of the auricular portion. In the anterior part of the palpebral portion there is a narrow streak of bundles directed obliquely upwards and forwards. The direction quite corresponds with that of the anterior bundles of the lower part of the auricular portion.

2. *Orbicularis-oculi-group.*

Pl. 16, fig. 24.

The *m. orbicularis oculi*, which is rather narrow, consists of circular bundles. Dorsad to these there is in the upper eyelid also a rather broad tract of bundles — so broad that it projects somewhat over the bony orbita — which arise at the anterior angle of the eye, running in a bow backwards, turning behind the posterior angle of the eye and ending here fan-wise. These

¹⁾ How far it posteriorly reaches on the neck we cannot decide, as the head with the anterior part of the neck was cut off for the sake of preservation.

bundles are partly covered by a small band of longitudinal bundles that arise at the posterior angle of the eye (*m. horizontalis*, comp. the Elk).

The *m. præorbicularis* is powerfully developed with bundles radiating both upwards and downwards. The ventral ones form a broad, flat, muscular body that arises from a line being the continuation of the anterior angle of the eye, for a large part inside and before the »lachrymal groove«. The bundles radiate like a fan downward, the posterior ones closely joining the orbicular bundles of the lower eyelid. The whole part radiating downward is almost completely covered, partly by the *m. nasolabialis*, partly by the palpebral portion of the sphincter profundus.

The dorsal fascicles, which have also a rather considerable development, radiate fan-wise from the anterior angle of the eye, upon the frontal surface and the dorsum of the nose. Posteriorly this part of the *præorbicularis* proceeds direct in a broad and flat muscular body, the *m. supraorbicularis*, which, from the upper eyelid, where the bundles thrust between the orbicular ones, spreads over rather a considerable part of the front.

The relation of the upward radiating bundles of the *præorbicularis* to the *m. nasolabialis* is to be particularly remarked. These two muscles completely join; the *m. nasolabialis* appears as an immediate continuation of these bundles. The *m. nasolabialis* forms a great, flat muscle, the bundles of which run obliquely down the face making for the upper lip. In the posterior part of the *m. nasolabialis* the fascicles, as described, form a continuation of the dorsal *præorbicularis* fascicles; but farther in front, new fascicles join from the dorsum of the nose, where they run, in an arc, from one side of the face to the other. The *m. nasolabialis* thus reaches into the very muzzle, where the fascicles insert themselves along the upper and lower margin of the nostril. In the extreme foremost part the tendinous branches of the *m. maxillo-labialis* thrust through the *m. nasolabialis*.

3. *M. maxillo-labialis*.

Pl. 11, fig. 5.

In the Wapiti the muscle arises fleshy from the maxillary bone, below, and behind, the foramen infraorbitale. The flat muscular body stretches forwards, gradually splitting into a series of extended narrow portions which, however, plainly show their mutual connection, bundles of fibres connecting one portion with another. Each portion passes into a thin tendon, which again splits into several branches. These tendinous branches radiate like a fan forwards; the upper turn up dorsad to the muzzle, those that follow insert themselves along the posterior circumference of the nostril, whereas the lower proceed into the upper lip. The tendinous branch that reaches highest dorsad, fuses with the corresponding one from the other side of the head to form a rather thick tendinous cord that runs down into the muzzle and the upper lip between the nostrils. On the upper tendon the muscular body proceeds a considerable distance along it (*a*, Pl. 11, fig. 5), to leave it a little behind the posterior corner of the nostril in the shape of a small muscular fascicle (*b*). From some of the tendons situated below there arise similar small muscular bodies (*c*, Pl. 11, fig. 5) that, like the upper bundle, pass forwards, crossing between the upward radiating bundles of the *m. nasalis*. Some of these bundles can only be followed between the *nasalis*-fascicles where they end, whereas others are inserted outside the cartilaginous nose.

4. Buccinator-group.

Pl. 16, fig. 5 and 6.

The *m. buccinatorius*. At the origin posteriorly from the upper and lower jaw the muscle forms only one layer; afterwards the fascicles push below each other so that they form a superficial transverse and a deep longitudinal layer. The superficial layer is, in the main, like that of the Zebu (v. below), but it is somewhat thinner than in the latter. The *pars rimana* (comp. Pl. 11, fig. 5, where the *pars rimana* is figured in the upper lip) is very powerful but, as in the Zebu, it does not form a closed

»sphincter«, the fascicles inserting themselves into the fibrous middle portion of the lips. The fascicles still reach considerably farther into the lips than in the Zebu.

The *m. depressor labii inferioris* is, in the main, as in the Zebu.

As to the details of the buccinator we make the following remarks. The superficial transverse and the deep longitudinal layer posteriorly pass so smoothly into each other that one can hardly fix the limit between them; but in front, about the anterior half of the buccinator, they are distinctly separated by a rather thick layer of connective tissue. Part of the bundles of the deep layer insert under way into the mucous membrane; the middle ones reach on to the angle of the mouth, whereas the upper ones, and the lower ones, in rather a considerable number, proceed into the lips, where they contribute to the formation of the *pars rimana*. Several bundles, particularly of the lower, turn, in front, into an arc upwards, crossing up between other of the longitudinal ones and inserting themselves into the mucous membrane (Pl. 16, fig. 6).

In the anterior half of the upper lip the longitudinal layer forms a *pars supralabialis*. Part of the *rimana*-fascicles originating from the longitudinal layer turn in an arc round the low angle between the gingiva and the mucous membrane of the upper lip inserting themselves into the intermaxillary bone immediately below this angle. These bundles, which have caudad a longitudinal, rostrad an oblique direction, are anteriorly followed by fibres, which are wholly oblique (and successively more transverse, that is to say dorso-ventrad), taking their origin from the intermaxillary bone and descending in an arc into the lip. As a direct continuation of these there is, quite in front, a strong muscular portion, which arises from the intermaxillary bone and radiates upward unto the inferior and anterior circumference of the nostril (Pl. 16, fig. 6). On dissecting the *pars supralabialis* from the inner side of the lip by removing the mucous membrane: it may appear that the last described, most anterior part forms an independent muscle; the fascicles radiate upwards and so cross the direction of the labial fascicles.

Inside this upwards radiating muscle there is a fascicle of transverse fibres from one cartilaginous wing of the nose to the other; it looks as if it were only a part of the *pars supralabialis*.

The *m. nasalis* (Pl. 11, fig. 5) is a rather large and full muscular mass, arising in the usual way from the intermaxillary and maxillary bones, and besides continuing the origin for some distance upon the soft nasal wall. Its fascicles are arranged in rows. The posterior part forms a flat body that lies outside the maxillary bone, mostly covered by the *m. maxillo-labialis*, and above this muscle thrusting its bundles between the fascicles of the *m. nasolabialis*. The anterior part of the *m. nasalis* forms rather a considerable muscular mass, whose bundles radiate into the space behind the nostril; the rows of fascicles appear between the tendinous branches of the *m. maxillo-labialis*.

The *m. mentalis* consists of a rather considerable mass of fascicles, from the lower jaw radiating fan-wise into the under lip and the chin.

5. *M. lateralis nasi*

(Pl. 11, fig. 5)

is small, and thin, arising from the anterior margin of the proc. nasalis of the intermaxillary bone and extending outside the soft nasal wall inserting into the mucous membrane.

Attached to the cartilaginous nose there are two small muscles that in the main agree with those mentioned in the Elk.

6. *M. rectus labii*

is present — at all events in the under lip.

4. ZEBU.

1. *Platysma-sphincter-group*.

The *sphincter superficialis* is wanting on the head.

The *platysma* is powerfully developed: the lower part forms

a rather broad continuous muscular body which, from the upper part of the neck, and from the regio submandibularis, turns on to the face, where with longitudinal fascicles it makes for the angle of the mouth. Here most of the fascicles end; whereas only a small part proceed into the lips. The upper part of the platysma sends its bundles, fan-wise, up over the masseter and the pars zygomatica. The bundles lie gathered in rather broad bands, that radiate over the said muscles and are held together by a thin aponeurosis. They reach so high up that they thrust between the fascicles of the orbicularis oculi and the postorbicularis. Altogether the whole of the platysma body forms a muscular plate with radiating bundles, where quite a smooth transition is found from the posterior bundles, which radiate almost transversally, to the anterior longitudinal ones.

The *pars zygomatica* behaves in the main as in the Wapiti but is more powerful.

The *m. sphincter profundus* behaves in the main as in the Camel; still both portions are broader and more powerful than in the latter.

2. Orbicularis-oculi-group.

Pl. 16, fig. 23.

The *m. orbicularis oculi* is made up, in the region nearest the palpebral margin, of sphincter fascicles that arise from, and insert themselves into, a long and powerful lig. palpebrale nasale. These are, in the upper eyelid, joined by fascicles that arise from the ligamentum, turn in an arc backwards behind the posterior angle of the eye, and end below it, spreading fan-wise. As a continuation of these fascicles there is a quite powerful *m. postorbicularis*, the bundles of which gradually increase in length posteriorly, so that they here extend to the actual frontal surface, where they thrust up partly below, partly between the bundles of the *m. supraorbicularis*. As in the Elk and in the Wapiti there is also in the Zebu, at the posterior angle of the eye, a band of longitudinal fascicles which, in the main, behaves as in those two animals, only it is more powerful in the Zebu: *m. horizontalis* (not figured in Pl. 16, fig. 23).

The *m. præorbicularis* is most powerfully developed. As in the deer described, there are, at the anterior angle of the eye, fascicles that radiate dorsad and ventrad; the fascicles are numerous, and form two broad, flat, rather full muscular bodies; this especially holds good of the ventral fascicles.

The *m. supraorbicularis* is large and powerful, forming a bulky, flat muscular body, which from the anterior angle of the eye — where it is closely connected with, and forms a direct continuation of, the præorbicularis dorsalis — and from the upper eyelid, in its whole length, radiates upon the frontal surface. Here it forms a broad, flat muscular body which covers the whole frontal surface (the »*m. frontalis*« of the Veterinary anatomy). The anterior fascicles radiate upon the front, but the following gradually bend more and more backwards, so that they become longitudinal in the posterior part of the muscular body.

The *m. nasolabialis* is rather weak; it shows its connection with the orbicularis complex by the fact that some of the dorsal præorbicularis fascicles turn down into it; these fascicles are joined by others, that come from the dorsum of the nose, running obliquely downwards and forwards. The fascicles go partly to the posterior circumference of the nostril, partly down into the upper lip. The muscular body proceeds over the cartilaginous nose, but is indeed here very thin, and pale. In this anterior portion the bundles have a quite transversal direction. The tendinous branches of the maxillo-labialis project from among them, and are used for insertion by some of the nasolabialis-bundles.

3. M. maxillo-labialis

arises partly fleshy partly with short tendinous bundles from the maxillary bone, below and behind the foramen infraorbitale. From its origin the muscular body is, by a deep but narrow fissure, which is filled with connective tissue, divided into an *upper* and

a *lower* portion; both of them are powerful, especially the lower one; which forms a full plump muscular body. The *upper portion* divides into three branches, each with a tendon, of which the upper, which is also the most powerful, turns up over the cartilaginous nose inserting itself into the muzzle with several tendinous radiating slips, whereas the two lower ones, each of which also splits into several branches, insert themselves along the posterior circumference of the nostril. The *lower portion* proceeds into the upper lip also dividing into several tendinous branches under way. From a couple of tendinous branches there come small muscular portions that project between the fascicles of the *m. nasalis*.

4. Buccinator-group.

Pl. 16, fig. 7 and 8.

The *m. buccinatorius* is very complicated in its structure; the bundles may be dissected out into three »layers«. At its origin, posteriorly, from the upper and lower jaw it behaves in the main as in the Elk. That is, it forms here only one layer; but the stratification of the muscle arises as the lower and the deep bundles partly continue the longitudinal direction, partly bend upwards and thrust in below the upper ones, which have gradually taken a perpendicular direction. This stratification begins much farther back in the Zebu than in the Elk. In the greater length of the *m. buccinatorius* three layers may be distinguished: of which the superficial one and the intermediate are separated from each other by a rather thick layer of adipose tissue, in which very numerous gl. buccales are imbedded. The ductus parotideus does not pierce the *m. buccinatorius*: a little in front of the *m. masseter* there is above the buccinator a small portion of mucous membrane which is quite without muscular fibres; here the salivary duct pierces the mucous membrane.

The *superficial layer* (Pl. 16, fig. 7) consists of transverse bundles that at the angle of the mouth proceed into the *pars rimana*, which is rather powerful but does not form a »sphincter«, the bundles only reaching halfway into the lips, where they insert themselves into the median fibrous part of the latter. Along the lower margin of the superficial layer there is a broad and rather full *m. depressor labii inferioris*, the bundles of which proceed longitudinally and thrust into the under lip and the chin. This depressor plainly shows its connection with the superficial layer of the buccinator, the posterior bundles turning from the latter direct into the *m. depressor*; these bundles are joined by others that emerge between the transverse bundles but in the deeper parts join them quite closely. Below this layer there is the *intermediate, longitudinal* one (Pl. 16, fig. 8). Its fascicles, however, are by no means so regularly arranged as is generally found in the longitudinal layer. Along the upper and lower margin of the layer there is a tract of longitudinal fascicles, part of which under way insert themselves into the mucous membrane, whereas others reach into the upper and under lips, and contribute to the formation of the *pars rimana* thrusting between its bundles. But between these two longitudinal tracts there is a broad stripe, where the fascicles rather soon take a slanting direction, downwards and forwards, in order to turn forwards again in the longitudinal direction towards the angle of the mouth where they end.

Deepest of all — immediately on the mucous membrane of the cheek — there is a *third layer* (not figured in Pl. 16) which posteriorly takes its origin from the deepest longitudinal fascicles. In front, the latter gradually bend upwards in a more and more slanting direction, and are continued forwards to about the angle of the mouth, by bundles that are directed obliquely upwards and forwards. They arise from, and insert themselves into, the mucous membrane, upwards partly thrusting between the fascicles of the upper longitudinal band of the intermediate layer.

In the upper lip there is a *pars supralabialis*. This does not extend through the whole length of the upper lip, reaching in front about below the middle of the nostril, and posteriorly to a couple of centimetres in front of the angle of the mouth. The

fascicles form a continuation of the upper longitudinal fascicles of the intermediate layer, and proceed in the usual way into the upper lip, where they, however, on account of the gingiva not extending far up, only form a low arc.

In front, from the intermaxillary bone, there arises a rather considerable muscular mass («grosser Erweiterer der Nasenlöcher», »*m. dilatator naris apicalis*» of the Veterinary anatomy) whose fascicles radiate upwards and insert themselves into the ventral and mediad circumference of the nostril. The whole forms a rather full muscular body, that in the median plane closely joins the corresponding one. The limit between them is indicated by a groove. This muscle is apparently an independent muscle, but a comparison with the Elk, and the Wapiti, shows that it no doubt corresponds to the anterior part of the rather singularly shaped *pars supralabialis m. buccinatorii* of the Elk (comp. Pl. 16, fig. 4).

The *m. nasalis* is strongly developed, and forms quite a considerable muscular mass, which arises from the intermaxillary bone and, in front, also from outside the soft nasal wall. The fascicles radiate up into the whole region behind and laterad of the nostril, inserting partially into its lateral and posterior circumference, partially into the skin of the upper lip. The fascicles arise in rows, by degrees higher and higher up, from the intermaxillary bone, which may easily be shown by dissecting down between the rows, in this way separating them from each other. The whole, however, forms a continuous muscular mass through which the tendinous branches of the *m. maxillo-labialis* proceed. The posterior part of the *m. nasalis* forms a rather broad flat bundle which extends obliquely upon the intermaxillary bone thrusting in between the bundles of the *m. nasolabialis*.

The *m. mentalis* forms rather a considerable muscular mass that arises from the lower jaw, with fascicles arranged in numerous rows, one below the other. They radiate into the under lip and the chin.

The fascicles are very coarse both in the *m. mentalis* and in the *m. nasalis*.

5. *M. lateralis nasi*

forms a flat but rather extensive muscular body that arises from the anterior margin of the *proc. nasalis* of the intermaxillary bone, extending outside the soft nose and inserting itself into the outside of the mucous membrane.

From the cartilaginous nose arises a muscle which radiates with its bundles upwards and outwards to the mediad, posterior and lateral circumference of the nostril.

6. *Mm. recti*.

M. rectus labii is at any rate present in the under lip, where the fascicles, moreover, are so coarse that they may be seen with the naked eye; they go, in the usual way, from mucous membrane to skin, crossing between the fascicles of the *m. mentalis*.

5. BOAR.

1. *Platysma-sphincter-group*.

Pl. 9 and Pl. 10, fig. 3.

The *sphincter superficialis* arises as a continuous, rather narrow, but full muscular body; partly from an aponeurosis outside the sternal muscles, but partly, and mostly, from the anterior end of the sternum, where in the median line it joins the corresponding muscle of the opposite side. The muscular body stretches upwards and outwards on the ventral face of the neck, turning with its longest fascicles (viz. the dorsal ones) a little on to the lateral surface of the neck. The muscular body spreads fan-wise, thereby growing gradually thinner, but still forming a closely united muscular plate.

As the muscular body turns from the ventral to the lateral face of the neck it meets the lower margin of the platysma, and is thereby split into two portions. The posterior and, also, the broader portion proceeds outside the platysma (v. Pl. 9) and the

fascicles end in short tendons that thrust into the subcutaneous adipose tissue. This adipose tissue extended also somewhat down between the fascicles, so that the latter, for some space, were quite surrounded by it. — The anterior portion (v. Pl. 10, fig. 3) is much narrower, and thrusts up under the platysma, where most of its bundles end in the adipose tissue inside the latter, about level with the margin of the lower jaw. A few of the posterior and deeper fascicles, however, turn in an arc into the *portio auricularis* of the *sphincter profundus*.

The *platysma* forms a powerful, broad and thick, continuous muscular plate that arises from a strong aponeurosis outside the muscles of the shoulder, extending across the face, and also, spreading into the *regio submandibularis*. Of the fascicles, which are very coarse, the upper turn in an arc up over the posterior part of the masseter, reaching up to the zygoma. Gradually they take the longitudinal direction and run with a slight downward convex curve upon the face where, in a long slanting line, they thrust themselves into the buccinator. The lower of these longitudinal fascicles reach to a transverse plane through the angle of the mouth. The fascicles partly insert themselves on the mucous membrane of the cheek, and partly (the anterior ones) reach the angle of the mouth and the under lip where they join the *rimana-fascicles*. Finally, we come to the lower part of the *platysma*. Here part of the bundles insert themselves into the lower jaw (v. Pl. 9) whereas most turn round the margin of the jaw into the *regio submandibularis* where, in a »raphe«-like stripe they join the *platysma-fascicles* from the other side, in front inserting themselves into an aponeurosis that extends to the *angulus mentalis*.

The *pars zygomatica* (Pl. 9) forms an independent muscle without any connection whatever with the rest of *platysma*. It arises with a long narrow tendon from the zygoma stretching obliquely downwards and forwards and thrusting in below the superficial layer of the buccinator at a considerable distance behind the angle of the mouth. The fascicles can be followed on to this. The muscular body itself is short and thin. Both the tendon and the muscular body are rather closely connected with some fascicles of the *portio palpebralis* of the *sphincter profundus*.

The *sphincter profundus* is present in the shape of two portions quite separated from each other.

The anterior one, the *portio palpebralis* (Pl. 9), arises from a thin aponeurosis inside the *platysma*. The muscular body is lamelliform, thin, and rather pale; its posterior fascicles run up into the lower eyelid where they mingle with the *orbicularis-fascicles*. The anterior ones reach so far on that they thrust up between the ventral *præorbicular* bundles. The very hindmost, rather short fascicles of the palpebral portion arise from the tendon of the *pars zygomatica platysmatis*; and a couple of the foremost fascicles turn in an arc forwards, joining its muscular body.

The *portio auricularis* (Pl. 10, fig. 3), at its origin from the base of *concha auris*, forms a round, rather full muscular body, which was quite surrounded by adipose tissue. As the muscular body runs downwards it splits into two portions: an anterior spreading down over the masseter and the anterior part of the parotis, — and a deep one, which is very interesting. It runs down as a narrow muscular chord inside the parotis, between the latter and the *gl. submaxillaris*; the anterior fascicles end about level with the margin of the lower jaw, turning in an arc forwards and partly thrusting in between the bundles of the anterior portion of the *sphincter superficialis*. The posterior fascicles on the contrary proceed downwards *passing direct into* the *sphincter superficialis*.

2. *Orbicularis-oculi-group*.

Pl. 16, fig. 25, and Pl. 9.

The *m. orbicularis* forms a rather broad muscular border both in the upper and lower eyelid, consisting of circular fascicles that arise from and insert themselves into the anterior angle of the eye.

Posteriorly the *m. orbicularis* is joined by a rather broad tract of *postorbicular* fascicles.

The *m. præorbicularis* is powerful. The ventral fascicles form a direct continuation of the sphincter-fascicles in the lower eyelid; but in front, the line of origin gradually proceeds higher and higher, so that the anterior downward radiating fascicles, arise rather high above the anterior angle of the eye. — The dorsal fascicles begin at the anterior angle of the eye extending backwards nearly the whole length of the upper eyelid. Thus the *m. præorbicularis dorsalis* proceeds direct into the *m. supraorbicularis* which therefore does not form a separate »muscle«. The fascicles form together a broad but thin muscular plate that extends high upon the front, especially is this the case with its anterior fascicles.

The *m. nasolabialis* by a long interval is separated from the rest of the orbicular complex (Pl. 9). It arises from about the anterior half of the dorsum of nose, where its origin almost reaches on to the anterior end of the nasal bone. The fascicles run downwards, the posterior ones also obliquely forwards, whereas the anterior gradually take more and more a transverse direction. Only the posterior fascicles reach quite down into the upper lip, where in the fold above the canine they thrust in between the rimana-fascicles. In front the fascicles gradually grow shorter, reaching only a short distance down the side of the upper lip, where they end in the skin being interwoven with the bundles of the *m. nasalis*.

3. *M. maxillo-labialis*

(Pl. 9)

forms a rather powerful muscular mass which arises from the lachrymal, zygomatic and maxillary bones, in the region above and behind the foramen infraorbitale. It divides into three portions: an upper, a middle and a lower, of which the latter apparently may be separated from the others from its origin. In depth, however, it is connected with the middle portion. This undermost portion forms a rather short but powerful round muscular body, which, with a long strong tendon, proceeds into the snout in the lower part of which it inserts itself, being split into several thin branches. The second, or middle, more fleshy portion, arises closely connected with the uppermost, gradually separating from it and radiating into the snout with a row of thin tendinous branches. The uppermost portion is the most powerful, and thickest, at the origin, where it is separated from the undermost portion by a narrow fissure filled with adipose tissue. After having separated from the middle portion, a little farther on it passes into a strong flat tendon that proceeds forwards, turning at last, at the anterior end of the nasal bones, on to the dorsum of nose where it joins the corresponding one inserting itself into the upper part of the snout. In this muscle there is a point that somewhat recalls what obtains in the Wapiti (comp. Pl. 11, fig. 5 *a, b*): To wit, from the tendon, immediately where it passes out of the muscular body, there arises a rather powerful fascicle that posteriorly passes immediately into the muscular body, taking otherwise its origin, for a couple of centimeters, from the lower margin and the inner surface of the tendon. The fascicle runs obliquely forwards, and downwards, lying mostly immediately over the bones, and inserting itself into the intermaxillary bone just above the origin of the *m. nasalis*. It is hardly to be doubted that it is really a fascicle of the portio superior *m. maxillo-labialis*. One might perhaps imagine that it were a fascicle of the *m. nasalis* which had inserted itself into the tendon of the portio superior (comp. e. g. the relations between the nasolabialis and the maxillo-labialis in some Mammals). But it seems to us that partly from the direction of the fascicles and partly and more particularly from the close connection with the muscular body of the portio superior of the *m. maxillo-labialis* the former conception appears by far the more probable. Also, with respect to the uppermost tendon of the middle portion, there is something similar, but here, indeed, it is only quite a thin narrow fascicle which from the muscular body ex-

tends obliquely downward and forward inserting itself into the intermaxillary bone.

4. Buccinator-group.

Pl. 16, fig. 15, and Pl. 9.

At its origin posteriorly from the upper and lower jaw the *m. buccinatorius* only forms one layer of longitudinal fascicles, but about midway the cheek, at a distance in front of the masseter, there is a crossing, part of the lower fascicles crossing obliquely up over the upper ones, and being continued farther forwards by transverse fascicles; so the buccinator appears with two layers in its anterior part: a superficial layer of transverse fascicles, and a deep layer of longitudinal fascicles.

The *transverse layer* forms rather a powerful stratum of fascicles that span in the usual way from the upper to the lower jaw. At the angle of the mouth it passes direct into the *pars rimana* which, both in the upper and lower lip, forms a very full muscular layer. In the upper lip the fascicles reach into the snout. The *pars supratlabialis* is greatly reduced; it is present only in the fold which the upper lip forms over the canine. On this space there arises a group of fascicles from the maxillary bone close above the gingiva extending in an arc downward, and forward, into the upper lip.

The rather powerful *longitudinal layer* proceeds inside the transverse layer ending at the angle of the mouth; some of the lower fascicles, however, reach into the under lip where they mingle with the fascicles of the *pars rimana*.

Finally there is a well marked *m. depressor labii inferioris*. It begins quite posteriorly, where it is to some extent intimately connected with the longitudinal fascicles of the buccinator, thereafter separating as a well defined, extended, muscular body, that soon passes into a bundle of thin tendinous branches that insert themselves into the under lip. The *m. depressor* is further limited from the rest of the buccinator by the fascicles of the platysma thrusting between these two (v. Pl. 9, where only the tendinous branches of the *m. depressor* are visible in front of the platysma; whereas the rest of the muscle is covered by the latter).

The *m. nasalis* (Pl. 9) forms a considerable muscular mass, the bundles of which arise in rows partly from the intermaxillary bone, partly outside the cartilaginous nose. The fascicles radiate outwards to the skin, the lower ones down into the upper lip, partly crossing out between the tendinous branches of the *m. maxillo-labialis*.

The *m. mentalis* (Pl. 9) also forms a very considerable muscular mass that arises from the lower jaw, the mostly coarse fascicles radiating down into the under lip and the »chin«.

The *m. lateralis nasi* is wanting.

6. TAPIR.

(*Tapirus americanus*.)

1. Platysma-sphincter-group.

Pl. 7.

The *sphincter superficialis* is wanting on the head.

The *platysma* is extremely well developed, forming a continuous, and by no means thin muscular plate over the lower part of the face. The muscular body begins on the anterior part of the ventral face of the neck; the inferior fascicles extend farthest back, whereas the origin of the superior ones reach farther and farther forwards the higher they lie, so that the whole muscular body, posteriorly, ends in a line running obliquely upwards; above this line the muscular body is continued by a fascia upward on the neck (in Pl. 7 this fascia has been dissected off). In the specimen investigated there was much adipose tissue imbedded in this fascia, as also in that part of the muscle situated nearest the origin; narrow stripes of loose adipose connective tissue extend between the fascicles, forcing them as it were somewhat from each other.

The muscular body now turns upwards, round the margin of the lower jaw, and radiates upon the face, covering a great part of the masseter and making for the angle of the mouth and the under lip. On a single spot above the lower part of the masseter there is an interruption in the muscular body about 3—4 cm high and about 1 cm broad, filled by a plate of adipose connective tissue.

On the face the fascicles run obliquely forwards, in the posterior part also upwards, that is, the whole muscular body forms a plate extended fan-wise. At the insertion the platysma-fascicles, as it were, separate into three portions, a separation that is produced in the following way: The upper margin of the muscular body ends in a line which goes from the zygoma obliquely forwards and downwards, towards the under lip, at first following the lower margin of the pars zygomatica; but a middlemost portion of the muscular body, about 3—4 cm broad, proceeds farther forwards, a rather great distance in front of this slanting line of insertion. In this way the insertion of the platysma is divided into three portions. The *intermediate portion* (b, Pl. 7) runs obliquely forwards towards the angle of the mouth and a little behind the latter the fascicles thrust between the fascicles of the m. buccinatorius. This portion, in front, joins the pars zygomatica so intimately that they apparently form a continuous muscular body. A close investigation of the course of the fascicles in this intermediate portion shows that it is only the lower fascicles that so intimately join the lower margin of the pars zygomatica as to form a direct continuation of it, whereas the rest partly dip below, partly cross between, the fascicles of the pars zygomatica, and radiate towards the upper lip, together with them, but covered thereby.

The fascicles of the *uppermost portion* (a, Pl. 7) of the platysma end along the lower margin of the pars zygomatica, here passing into a thin fascia that proceeds up over this muscle. The *undermost portion* (c, Pl. 7) joins the m. buccinatorius. It makes for the lower margin thereof at a rather considerable distance behind the angle of the mouth (corresponding to a plane through the anterior angle of the eye). Here is a tendinous portion of the buccinator, and into this the superficial fascicles of the undermost portion of the platysma insert themselves.

The *pars zygomatica* forms a distinct, rather powerful muscle, which arises with a short aponeurosis from the anterior part of the zygoma running forwards in a downward convex arc. The fascicles partly end at the angle of the mouth where they thrust between the fascicles of the pars rimana together with the fascicles from the intermediate portion of the platysma, and they partly radiate upwards, towards the upper lip, being interwoven between the fascicles of the m. nasolabialis.

The *m. sphincter profundus*. Of this muscle the *portio auricularis* is present in the shape of a real sphincter that from one side of the head turns in an arc below the anterior part of the neck on to the other side. It inserts itself on the outside of the base of the auricle, so that the muscular body partly forms a sling from one auricle to the other. This sphincter-shaped arrangement of the fascicles however only applies to about the posterior half of the muscle. On the ventral face of the neck the sphincter is rather broad with plenty of adipose intramuscular connective tissue between the fascicles; but as soon as it turns on to the parotis it decreases considerably in breadth, the fascicles closing near together. In front the muscular body proceeds in a rather powerful fascia that extends on the face inside the platysma (most of the fascia has been dissected off in Pl. 7), and from this fascia all the anterior fascicles of the auricular portion arise. They arise in a straight line drawn perpendicularly down through the middle of the maxillary joint, the upper fascicles taking their origin close below this articulation. All the fascicles coming from the fascia intimately join the posterior ones. If the fascicles be traced from the insertion of the muscle on the auricle it will be found that the anterior ones run at first perpendicularly downwards, and then turn in an arc forwards, close below the maxillary joint. The succeeding fascicles radiate more and more obliquely downwards, and the

posterior ones run straight downward, only on the neck spreading fan-wise. The auricular portion, altogether, forms a broad strong muscular plate with rather coarse fibres.

Below the eye there is a flat portion of muscular fibres about 1½ cm broad (vide Pl. 8) that arises from the tendinous portion of the buccinator, into which part of the fascicles of the platysma insert themselves (comp. Pl. 7). The fascicles run upwards, at first quite closely joining the transverse fascicles of the buccinator, but gradually they separate from them and now ascend as a continuous muscular body towards the lower eyelid, where they thrust between the orbicular and præorbicular fascicles. The relations between this muscular body and the orbicularis correspond exactly to those found in the *portio palpebralis* m. sphincteris profundi of the other Ungulates, for which reason we are of opinion that this muscular body in the Tapir must be regarded as the portio palpebralis, which then, secondarily, at its origin has more closely joined the m. buccinatorius. The muscular body is mostly covered by the pars zygomatica and the platysma proper (comp. Pl. 7 and 8; in Pl. 7 the fascicles of the portio palpebralis are seen projecting above the upper margin of the pars zygomatica).

2. Orbicularis-oculi-group.

Pl. 7 and Pl. 16, fig. 27.

The *m. orbicularis oculi* with the m. præ- and postorbicularis forms a broad ring round the eye; but in front, between the dorsal and ventral præorbicular fascicles, there is a notch quite filled by the m. nasolabialis. The whole muscular group appears as a continuous whole.

The orbicular fascicles arise from a broad, thick, and powerful lig. palpebrale nasale running in an arc through the lower eyelid, and turning up behind the posterior angle of the eye into the upper eyelid unto the same ligamentum. The whole forms a rather powerful, broad, ring, so broad that it reaches beyond the bony entrance of the orbita.

The *m. præorbicularis* arises from the lig. palpebrale and radiates dorsad and ventrad. Dorsally there is formed a thick fan-shaped portion that covers the anterior part of the orbicular fascicles of the upper eyelid, and a rather considerable part of the origin of the m. nasolabialis. — The ventral fascicles are numerous, and radiate downward, and so form a great, flat, fan-shaped muscular body, posteriorly joining the orbicular ones in the lower eyelid, so closely that no limit can be shown. In front, also without any traceable limit, they join the m. nasolabialis.

The *m. postorbicularis* forms a rather broad tract of fascicles that run down along the posterior circumference of the orbicularis, lying close to it. The fascicles extend, both above and below, far beyond the orbicularis. Posteriorly the curve gradually straightens somewhat, so that the posterior margin of the muscle forms an almost straight line, which only towards the ends, bends a little forwards. This posterior margin extends for some considerable distance on the m. temporalis being separated therefrom by a thick layer of adipose tissue.

Dorsally there is another, flat, broad, but rather thin muscular body that arises high up, partly from the nasal bone, partly outside the cartilaginous nose, stretching down inside the dorsal præorbicular fascicles, and ending in the upper eyelid. Judging from its situation — particularly its relations to the upper eyelid — this muscle must certainly be regarded as the *m. supraorbicularis*, although, indeed, it does not, as in the other Ungulates, appear as a direct continuation of the præorbicularis dorsalis but rather as a deeper layer of it.

The *m. nasolabialis* arises with a broad aponeurosis which begins upon the dorsum of the nose where it is interwoven with the periost of the nasal bones. From this point the aponeurosis stretches across the cartilaginous nasal capsule and then further takes origin from the maxillary bone, in the region in front of the orbita down to the lig. palpebrale, with which it amalgamates. The part of the aponeurosis arising from the dorsum of the nose is broad, so that the muscular fascicles arise from the aponeurosis

at a distance outside the lateral margin of the nasal bone, in a posteriorly convex line. Down the maxillary bone the aponeurosis gradually grows more and more narrow, and the undermost fascicles arise direct from the lig. palpebrale. The muscular body is flat, broad, and rather powerful and extending on to the lateral face of the trunk. The fascicles run obliquely downwards and forwards; the dorsal fascicles are the longest and reach out to the dorsal circumference of the nostril. The following fascicles gradually decrease in length; they insert themselves into the lateral and ventral circumference of the nostril, whereas the fascicles of the posterior part of the muscle go obliquely down into the upper lip, along its whole length thrusting inside the pars rimana. The hindmost fascicles have a direction from the anterior angle of the eye (the lig. palpebrale) almost towards the angle of the mouth, joining the anterior ventral fascicles of the m. præorbicularis so intimately that no limit can be set between these two muscles. Above, on the dorsum of the nose, the aponeurosis is covered by the m. supraorbicularis, whereas the part in front of the eye is covered by the dorsal præorbicular fascicles.

The m. nasolabialis covers a great part of the m. maxillo-labialis. As to the lower portion of the m. maxillo-labialis it appears on the lateral face of the trunk, dorsad to the m. nasolabialis (Pl. 7). At first the two muscular bodies are to be distinguished plainly from each other, the dorsal fascicles of the lower portion of the m. maxillo-labialis running obliquely forwards and upwards; but afterwards, the fascicles of the latter increase in length, bending more and more downwards, and at last joining the dorsal margin of the m. nasolabialis so intimately, that in front, on the trunk, no limit whatever can be seen between the two muscles (comp. Pl. 14, fig. 3).

3. M. maxillo-labialis.

Pl. 8, fig. 2, and Pl. 7.

The two portions of the m. maxillo-labialis are separated as two distinct muscles. The *portio superior* is a powerful muscle which arises with quite short tendons (partly fleshy) in front of and above the orbita, in a line from the frontal bone on to the maxillary and the lacrymal bones, almost down to the lig. palpebrale. On the frontal bone the origin is from the crest which this bone sends up laterad to the cartilaginous nasal capsule. Being broad and flat at the origin it soon contracts into a narrow but rather full muscular body that turns in an arc on to the dorsal face of the trunk, reaching, a little in front of the cartilaginous nose, to the median line, and blending with the corresponding muscle of the other side (Pl. 14, fig. 3); it may be followed on the dorsal face of the trunk to the very end (a distinct groove is formed on this face for the muscle to lie in). Gradually it grows narrower, producing flat, thin, aponeuroses that insert themselves into the dorsal face of the trunk, and ends in a narrow tendon that can be followed to the very end of the trunk (inserting itself into the skin dorsally in the median line). — The posterior end of the muscular body is completely covered by the m. nasolabialis.

The *portio inferior* arises with a flat, not very broad, rather powerful aponeurosis, from the maxillary bone below the foramen infraorbitale, so that it is separated from the origin of the portio superior by a rather considerable interval. From the aponeurosis the fascicles radiate on to the lateral surface of the trunk, to a great extent covered by the nasolabialis. The origin itself is covered partly by this muscle partly by the ventral fascicles of the m. præorbicularis. The muscular body of the portio inferior is flat and flabellate. Its uppermost fascicles run obliquely upwards and forwards crossing the fascicles of the nasolabialis; the next fascicles increase in length, going more and more in upward arcs, so that, as to direction they closely join the fascicles of the nasolabialis (v. above). The fascicles of the portio inferior radiate partly up towards the dorsal face of the trunk, partly forwards on its lateral surface, where they can be followed towards the dorsal and lateral circumference of the nostril.

4. Buccinator-group.

Pl. 16, fig. 9, 10, 11; Pl. 8, fig. 2; Pl. 7.

The m. buccinatorius at its origin from the upper and lower jaw, forms a single layer of longitudinal fascicles (Pl. 8, fig. 2); but a little farther on the upper fascicles alter their direction running transversally downward, so that the m. buccinatorius throughout the greater part of its length consists of a superficial transverse, and a deep longitudinal layer. The transverse fascicles, however, do not form a continuous layer throughout; about midway there is a discontinuity whereby the longitudinal layer become exposed. This discontinuity is, by the way, mostly filled by the portio palpebralis m. sphincteris profundi (v. above). Towards the angle of the mouth the fascicles of the transverse layer are more closely set and proceed directly into the broad and powerful *pars rimana*, which does not unite in front with that of the other side. On the trunk the anterior part of the *pars rimana*, which ends at the ventral side of the nostril, cannot be distinguished from m. nasolabialis (comp. Pl. 14, fig. 3).

The longitudinal layer of the buccinator is very strongly developed and forms a continuous layer, the uppermost fascicles of which can be traced for some distance into the upper lip; the next reach to the angle of the mouth (Pl. 8, fig. 2), and the undermost insert themselves into the mucous membrane of the cheek.

Some of the uppermost and deepest fascicles of the longitudinal layer run in a curious, odd way, since they bend downwards in front (Pl. 16, fig. 11), so that for a space of 4—5 cm behind the angle of the mouth there is a portion where the buccinator seemingly appears with three layers.

The *pars supralabialis* (Pl. 8, fig. 2) takes its origin from the maxillary bone and extends into the upper lip inside the *pars rimana*; it has no connection with the longitudinal fascicles of the buccinator and presents only a limited area in the shape of a small muscular plate behind the middle of the length of the upper lip; the inferior ends of its fascicles are directed somewhat forward.

No *depressor labii inf.* is formed as a distinct muscle; nevertheless we must here add the following: In front, at the lower margin of the transverse layer, there is a tendinous portion (Pl. 8, fig. 2) into which some platysma-fascicles and the portio palpebralis m. sphincteris profundi insert themselves. From this tendinous portion there arises a tract of longitudinal fascicles that thrust into the under lip; but upwards they join the *pars rimana* so closely (Pl. 7) that no limit whatever can be shown between them.

The m. *nasalis* forms a rather considerable muscular mass that arises along the upper margin of the maxillary bone radiating upwards; in Pl. 8, fig. 2 the upper fascicles are seen above the portio inferior of m. maxillo-labialis. The whole forms a flat muscular body with rather thin fascicles imbedded in a somewhat solid intramuscular connective tissue. The fascicles have not quite a dorsad direction, but are running obliquely dorso-caudad, and are regularly disposed in series or blades. From their origin on the bone they pursue an arcuate course below the nasal tube, and are then turned upwards onto the lateral face of the soft nose, where they end.

The m. *mentalis* is a rather considerable muscular mass that arises from the anterior part of the lower jaw and radiates with its fascicles out to the skin crossing out between the rimana-fascicles. The fascicles lie imbedded in a rather plentiful mass of adipose connective tissue; in Pl. 8, fig. 2 the fascicles cut through are seen in the adipose tissue above the part of the rimana that is still preserved.

5. M. rectus nasi et labiorum.

Pl. 14, fig. 3; Pl. 8, fig. 2; Pl. 7.

The m. *rectus nasi* forms a very considerable system of thin fine fibres which radiate out from the whole circumference of the nasal tube. They arise from the mucous membrane of the

nose throughout the whole length of the trunk. They are most numerous and closest in the ventral and medial circumference of the nasal tube whereas they are more scattered dorsally and laterally, where they radiate out through a thick layer of numerous, small lobulate glands. Also medially and ventrally there are a number of glands imbedded between the fascicles of the rectus, but by no means so numerous as in the dorso-lateral circumference. If the fascicles are followed along the periphery of the nasal tube the following facts can be made out: Dorsally they are, as we have remarked, rather scattered, thrusting up between the glands and inserting themselves into the skin; farther down, laterally, they are seen radiating out between the glands, then thrusting out between the fascicles of the *m. naso- and maxillo-labialis*, which in this part of the trunk only forms a thin layer (Pl. 14, fig. 3), finally to be inserted into the skin. The fascicles turn quite smoothly down to the ventral circumference of the nasal tube. If the ventral fascicles are followed through the whole length of the trunk, we find that, on the proximal portion, where the trunk ventrally borders on the intermaxillary and maxillary bones, they are short and rather scattered, separated from each other through rather plentiful connective adipose tissue. Distad they increase in number and length forming, on rather more than the distal half of the trunk, a thick mass of close thin fibres. Some of the outmost of these, having first, near the mucous membrane, the same direction as the rest, viz. dorso-ventrad, take a transverse direction and form a *horizontal muscular layer* (Pl. 14, fig. 3, *b*) below the rest and above a large ventral glandular mass. Others of the ventral rectus-nasi fascicles (Pl. 14, fig. 3, *a*) have an oblique direction and run obliquely through the lateral longitudinal muscular sheath of the trunk consisting of the *pars rimana*, *m. nasolabialis* and *m. maxillo-labialis*. — If the dorsal fascicles are followed mediad, they turn, almost imperceptibly altering their direction, down into the septum between the nasal tubes, here running transversely from one nasal tube to the other. Proximad they are somewhat scattered but soon increase rather considerably in number distad, so that they form a close layer of transverse fascicles through the septum.

As to the rectus-bundles of the *upper lip* we find a continuous layer thereof going from the horizontal layer of rectus-bundles described above into the lateral margin of the proboscis, the tips of the fascicles extending into the *pars rimana* (Pl. 8, fig. 2 and Pl. 14, fig. 3, *c*).

In the *lower lip* there are also rectus-bundles, traversing the lip from the mucous to the cutaneous side.

7. HORSE.

As to the facial muscles of the Horse we shall here mention only a few facts that are of particular interest for the investigations in hand; otherwise referring to the accounts given in Veterinary-anatomical treatises.

1. *Platysma-sphincter-group*.

The *sphincter superficialis* does not reach the head.

The *platysma* (= the *m. cutaneus labiorum* of the Veterinary anatomy) arises from an aponeurosis from the occiput. The lower part of the *platysma* forms a narrow, more or less continuous muscular layer that proceeds towards the angle of the mouth, where the fascicles are interwoven in the buccinator. The upper part, which radiates over the masseter, shows great variations in its development; now forming a rather continuous muscular body, and now represented only by scattered fascicles.

The *pars zygomatica* is completely separated from the *platysma*.

The *sphincter profundus*. Of this, the *portio auricularis* (= the *m. auricularis inferior* of the Veterinary anatomy) is present. As to the *portio palpebralis* we are not quite sure if the *m. malaris* of the Veterinarians (Pl. 8, fig. 1) is this muscle. There is con-

stantly found a thin, flat muscle that extends from the crista facialis, where it arises from the fascia, obliquely upwards and backwards to the lower eyelid; this direction of the fascicles, indeed, is different from that which we have otherwise found in the *portio palpebralis*; but on the other hand this muscle can hardly be considered as belonging to the orbicularis-group.

2. *Orbicularis-oculi-group*.

Pl. 16, fig. 26; Pl. 8, fig. 1.

The *m. orbicularis oculi* consists of circular fascicles. There is a *m. præorbicularis*, whose dorsal portion is continued posteriorly by a large *m. supraorbicularis* extending upon the frontal surface (the *m. corrugator supercilii* of the Veterinary anatomy). As to the *m. postorbicularis* we have found two small portions of slanting fascicles that closely join the orbicular fascicles in the upper and lower eyelid.

The muscular body of the *m. nasolabialis* is frequently quite separated from the *m. orbicularis*; only now and then it reaches so far back that it immediately joins the *m. præorbicularis*. The whole of the inferior part of the *m. maxillo-labialis* breaks through the *m. nasolabialis* so that the latter is, anteriorly, split into a superficial and a deep (resp. a ventral and a dorsal) portion.

3. *M. maxillo-labialis*

(Pl. 8, fig. 1.)

is, as in the Tapir, divided into two independent muscles; the upper portion (the *m. levator labii sup. propr.* of the Veterinary anatomy) being quite separated from the lower portion (the *m. caninus* of the Veterinary anatomy).

4. *Buccinator-group*.

Pl. 8, fig. 1; Pl. 16, fig. 12, 13, 14.

From the anterior margin of the ramus ascendens of the lower jaw, from the adjoining mucous membrane of the cheek and from the upper jaw, there arises a massive bundle of longitudinal fibres with a long narrow tendon; on the upper jaw, the fascicles arise in a long row just above the gingiva. If we follow the superficial longitudinal fascicles onward (Pl. 16, fig. 12), they gradually pass into a superficial layer of transverse fascicles which, indeed, in the posterior part, are interrupted by a longitudinal tendinous stripe from which the fascicles, running upwards and downwards, arise. Thus, only the downwards directed fascicles form a direct continuation of the superficial longitudinal fascicles, whereas those running upwards appear like an independent layer. In the anterior half, on the contrary, the transverse fascicles run continuously from the upper to the lower jaw.

Below this transverse layer the deep longitudinal fascicles proceed, in the form of a continuous layer, to the angle of the mouth (Pl. 16, fig. 13). From the lower margin of the longitudinal layer a portion is split off, *m. depressor labii inf.*, and runs as an extended, flat, narrow, muscular body to »the chin«.

Finally, there is, at about the middle third of the deepest part of the cheek — close to the mucous membrane — a layer of perpendicular fascicles (Pl. 16, fig. 14). This layer also originates from the longitudinal fascicles, a deep fascicle of the latter bending upwards, and being continued farther on by fascicles that gradually take the perpendicular direction.

At the angle of the mouth the superficial transverse layer bends into the lips forming a very powerful and thick *pars rimana*. The *pars supralabialis* (the *m. incisivus superior* of the Veterinarians) is well developed, reaching with its origin almost on to *i₂*, and having its fascicles arranged in the usual way.

The *m. nasalis* is composed of three series of fascicles, arising from the intermaxillary bone a little above the gingiva in the range from *c* to *i₂*. Every series forms a flat, rather narrow layer; the two hindmost run obliquely upwards and backwards and it would seem that the fascicles end in the connective tissue inside the *m. nasolabialis* and *maxillo-labialis*; how far they —

in the usual manner — radiate out between the fascicles of the said muscles unto the skin, we have not been able to decide. In the anterior series the fascicles are directed towards the ventral circumference of the nostril. In Veterinary anatomy this muscle is described as part of the »m. incisivus sup.«; but its origin, its place and the arrangement of its fascicles speak decidedly for the interpretation of it as m. nasalis, though the direction of the fascicles is somewhat different from what we have found elsewhere; nor have we been able to follow the fascicles unto the skin.

5. M. lateralis nasi,

(Pl. 8, fig. 1)

is a pale muscular frame along the margin of the apertura pyriformis. Its ventral part forms a rather full muscular mass (particularly full anteriorly); it is associated with much loose, partly adipose, connective tissue between the fascicles; it arises from the intermaxillary and maxillary bones, the fascicles turning round the margin of the apertura pyriformis and inserting themselves into the soft nasal wall (this part of the muscle is the m. cartilaginiis conchæ inferioris et superioris of GÜNTHER¹⁾). The line of origin posteriorly turns behind the apertura and the fascicles from hence run obliquely forwards and downwards (the m. dilatator nasi superior of GÜNTHER); this posterior part of the muscle is not always equally well and distinctly developed (in the specimen figured it is very distinct); it was even completely

¹⁾ GÜNTHER, Die topographische Myologie des Pferdes, 1866.

wanting in one Horse's head which we examined. Farther in front the fascicles arise from the nasal bone, a little within its free margin, and from the margin of the cartilaginous nose; in this range the fascicles run down onto the soft nasal wall. The muscle passes, without sharp limits, into the deep fascicles of the m. transversus nasi. (This anterior part of the muscle corresponds to GÜNTHER's m. dilatator nasi anterior.)

The m. transversus nasi forms a rather considerable muscular mass in the region between the nostrils. The superficial fascicles (GÜNTHER's m. transversus nasi superficialis, ELLENBERGER und BAUM's m. transversus nasi, pars superficialis) run transversely between the mediad margins of the nostrils. The Veterinary authors, to which reference here been made, however, have not noticed that these superficial fascicles only insert themselves into the skin. The deeper parts of the muscle form a dense mass of transverse fascicles (GÜNTHER's m. transversus nasi profundus, ELLENBERGER und BAUM's m. transversus nasi, pars profunda), which extends from one cartilaginous »nasal wing« to the other, as well between the »laminæ« as between the »cornua«. These deep fascicles pass upwards, immediately, into the m. lateralis nasi. Downwards the deep and the superficial fascicle pass without limits into the pars rimana. Finally there are, at the very deepest, some fascicles that gradually take a slanting direction so that they form a couple of crossing portions, and as an immediate continuation of these there is a thin muscular plate that arises from the convex margin of the cornu extending in below the soft nasal wall where they insert themselves (GÜNTHER's m. dilatator nasi inferior).

INDEX.

- Adductor externus, m.
in Equus 19.
— Elephas 45.
- Adductor inferior, m.
in Didelphys 21, fig. A.
— Halmaturus Pl. 13 fig. 2.
— Placental Mammals Pl. 15 fig. 4.
— Centetes 22, fig. B.
— Tapirus Pl. 7.
— Equus 19.
— Sus 19, Pl. 9.
— Camelus Pl. 5.
— Cervus alces 19.
— Bos 19.
— Canis 19, Pl. 12, Pl. 15 fig. 5.
— Elephas 44, Pl. 1, Pl. 15 fig. 7.
- Adductor medius, m.
in Placental Mammals Pl. 15 fig. 4.
— Tapirus 18.
— Equus 18.
— Sus 18, Pl. 9.
— Cervus alces 18.
— Bos 18.
— Canis 18, Pl. 12, Pl. 15 fig. 5.
— Lepus 18.
- Adductor superior, m. 16.
- Anteri scxti, m.
in Halmaturus 21, Pl. 13 fig. 2.
— Placental Mammals Pl. 15 fig. 4.
— Equus 19.
— Sus 19.
— Camelus Pl. 5.
— Cervus alces 19.
— Canis 19, Pl. 12.
— Lepus 19.
— Elephas 46, Pl. 1.
- Antitragicus, m., in Homo 19.
- Antitrigo-posterus, m., in Lepus 20.
- Auricularis inferior, m., in Equus 71.
- Auricularis posterior Ruge, m. 5, 18.
- Auricularis superior Ruge, m. 6.
- Auriculo-labialis inferior Ruge, m. 5.
- Auriculo-labialis superior Ruge, m. 5.
- Auriculo-occipitalis-group, in general 17.
in Elephas 44.
- Auriculo-occipitalis Ruge, m. 5.
- Auriculo-occipitalis, m.
in Didelphys 20, fig. A, Pl. 15 fig. 3.
— Halmaturus 21, Pl. 13 fig. 1-2.
— Placental Mammals Pl. 15 fig. 4.
— Centetes 22, fig. C.
— Tapirus 18, Pl. 7.
— Equus 18.
— Sus 18, Pl. 9.
— Camelus Pl. 5.
— Cervus alces 18, Pl. 15 fig. 6.
— Bos 18.
— Canis 17, Pl. 15 fig. 5.
— Lepus 18.
— Elephas 44, Pl. 1, Pl. 15 fig. 7.
- Brachiocephalicus, m.
in Sus Pl. 9.
— Canis Pl. 12.
- Buccinator-group, in general 13.
in Echidna 13.
— Halmaturus 13.
— Erinaceus 14.
- in Ungulata 14.
— Tapirus 14, 70.
— Equus 14, 72.
— Sus 66.
— Camelus 53.
— Cervus canadensis 59.
— Cervus alces 56.
— Bos 14, 62.
— Canis 14.
— Lepus 15.
— Myopotamus 15.
— Lemur 15.
— Elephas 33.
- Buccinatorius Ruge, m. 6.
- Buccinatorius, m., in general 15, Pl. 17 fig. 3-4.
in Echidna 13, Pl. 10 fig. 1-2.
— Halmaturus 13, Pl. 13 fig. 2-3.
— Erinaceus 14, Pl. 16 fig. 18.
— Ungulata 14.
— Tapirus 14, 70, Pl. 7, Pl. 8 fig. 2, Pl. 16 fig. 9-11.
— Equus 14, 72, Pl. 8 fig. 1, Pl. 16 fig. 12-14.
— Sus 14, 66, Pl. 9, Pl. 16 fig. 15.
— Camelus 53, Pl. 5, Pl. 6, Pl. 11 fig. 4, Pl. 16 fig. 1-2.
— Cervus canadensis 14, 59, Pl. 11 fig. 5, Pl. 16 fig. 5-6.
— Cervus alces 56, Pl. 11 fig. 1, Pl. 16 fig. 3-4.
— Bos 14, 62, Pl. 16 fig. 7-8.
— Canis 14, Pl. 16 fig. 17.
— Nasua Pl. 11 fig. 2.
— Lepus 15, Pl. 16 fig. 19.
— Myopotamus 15, Pl. 14 fig. 4.
— Lemur 15.
— Elephas 33, Pl. 1, Pl. 2, Pl. 3, Pl. 4, Pl. 16 fig. 16.
- Caninus Ruge, m. 6.
- Cartilage, auricular
in Echidna Pl. 10 fig. 2.
— Halmaturus Pl. 13 fig. 3.
— Talpa Pl. 15 fig. 1.
— Canis Pl. 15 fig. 5.
- Cartilage, nasal
in Tapirus Pl. 7, Pl. 8 fig. 2.
— Cervus canadensis Pl. 11 fig. 5.
— Nasua Pl. 11 fig. 2.
- Cartilaginis conchæ inferioris Günther, m.
in Equus 73.
- Cartilaginis conchæ superioris Günther, m.
in Equus 73.
- Cartilaginous septum of nose
in Elephas Pl. 14 fig. 11.
- Cartilaginous wing of nose
in Elephas Pl. 14 fig. 11.
- Complexus, m., in Elephas Pl. 3.
- Corium of Elephas 25.
- Corrugator supercilii, m.
in Equus 72.
— Cervus alces 55.
- Cutaneous labiorum, m., in Equus 71.
- Deltoidcus, m., in Sus Pl. 9.
- Depressor helicis Ruge, m. 6.
- Depressor labii inferioris, m.
in Ungulata 14.
— Tapirus 70, Pl. 8 fig. 2.
— Equus 72, Pl. 8 fig. 1, Pl. 16 fig. 13.
— Sus, 66, Pl. 9, Pl. 16 fig. 15.
— Cervus canadensis 60, Pl. 16 fig. 5.
— Cervus alces 56, Pl. 16 fig. 3.
— Bos 62, Pl. 16 fig. 7.
- Depressor proboscidis, m.
in Elephas 38, 42.
- Depressor tarsi Ruge, m. 6.
- Digastricus, m.
in Halmaturus Pl. 13 fig. 3.
— Elephas Pl. 2, Pl. 3.
- Dilatator naris apicalis, m., in Bos 63.
- Dilatator nasi anterior Günther, m.
in Equus 74.
- Dilatator nasi inferior Günther, m.
in Equus 74.
- Ear, muscles of the external, in general 16.
in Monotremata 22.
— Marsupialia 20.
— Didelphys 20, Pl. 15 fig. 3, fig. A.
— Placentals with a scutellum 16.
— Placentals without a scutellum 21.
— Centetes 21.
— Elephas 43.
- Ear-opening, in Elephas Pl. 2.
- Epicranialis, m., in Dog 18.
- Facial muscles of Mammals generally 5.
— — — Elephas 25.
- Facialis, n. 24
in Tapirus Pl. 7.
— Camelus Pl. 5.
— Elephas Pl. 1.
- Fissuralis, m.
in Halmaturus 21, Pl. 13 fig. 2.
— Placental Mammals Pl. 15 fig. 4.
— Equus 20.
— Sus 20, Pl. 9.
— Cervus alces 20.
— Canis 19.
— Lepus 20.
- Foramen infraorbitale,
in Tapirus Pl. 8 fig. 2.
- Frontalis, m., in Bos 61.
- Glands, glandulæ, buccales
in Tapirus Pl. 8 fig. 2.
— Camelus 53, Pl. 6.
— Cervus alces 57.
— Bos 62.
— Myopotamus Pl. 14 fig. 4.
— Elephas 33, Pl. 3.
- cutaneous, in Elephas Pl. 1.
- in the eyelids, in Elephas Pl. 2.
- labiales,
in Tapirus Pl. 8 fig. 2.
— Camelus 53, Pl. 6.
- lymphatic,
in Sus Pl. 9.
— Camelus Pl. 5.
- in Tapirus 71, Pl. 7, Pl. 8 fig. 2, Pl. 14 fig. 3.
- — Lepus Pl. 16 fig. 19.
- Glands, sebaceous, in Talpa Pl. 14 fig. 1.
— , submaxillaris,
in Echidna Pl. 10 fig. 2.
— Sus Pl. 10 fig. 3.
- Hairs of Elephas 25.
- Helicis Ruge, m. 6.
— major, m. 19.
— minor, m. 19.
- Horizontalis, m., in general 10.
in Cervus canadensis 10, 59, Pl. 16 fig. 24.
— Cervus alces 10, 55, Pl. 16 fig. 22.
— Bos 10, 61.
— Canis 10, Pl. 12.
- Incisivus superior, m., in Equus 72.
- Infraorbitalis, n.
in Halmaturus Pl. 13 fig. 3.
— Equus Pl. 8 fig. 1.
— Camelus Pl. 11 fig. 4.
- Lachrymal duct, in Talpa Pl. 14 fig. 1.
- Lateral nasal gland, duct of, in Talpa Pl. 14 fig. 1.
- Lateralis nasi, m., in general 15, Pl. 17 fig. 4.
in Equus 73, Pl. 8 fig. 1.
— Sus 66.
— Cervus canadensis 60, Pl. 11 fig. 5.
— Cervus alces 57, Pl. 11 fig. 1.
— Bos 63.
— Canis 16, Pl. 12.
— Elephas 39, Pl. 3, Pl. 14 fig. 11.
- Levator brevis, m., in general 17.
in Didelphys 21.
— Placental Mammals Pl. 15 fig. 4.
— Tapirus 17.
— Equus 17, 20.
— Camelus Pl. 5.
— Cervus alces 17.
— Bos 17.
- Levator labii Ruge, m. 5.
- Levator labii superioris proprius, m.,
in Equus 12.
- Levator medius, m. 18.
- Levator palpebræ superioris, m.
in Elephas Pl. 3.
- Levator proboscidis, m., in Elephas 31, 38, 42.
- Ligamentum palpebrale nasale 10, 11.
in Tapirus 68, Pl. 7.
— Cervus alces 55.
— Bos 61.
— Elephas 28, Pl. 1.
- Longissimus, m., in Elephas Pl. 3.
- Longitudinal fibrous leaves on the proboscis
in Elephas 31, 41, Pl. 2, Pl. 14 fig. 2, fig. D.
- Longus capitis, m., in Elephas Pl. 3.
— colli, m., in Elephas Pl. 2, Pl. 3.
- Malaris, m.
in Equus 71.
— Cervus alces 55.
- Mandibulo-auricularis Ruge, m. 6.

- Masseter, m.
in Halmaturus Pl. 13 fig. 3.
— Erinaceus Pl. 11 fig. 3.
— Talpa Pl. 15 fig. 1.
— Elephas Pl. 1-3.
- Mastohumeralis, m., in Elephas Pl. 2.
- Maxillo-labialis Ruge, m. 6.
- Maxillo-labialis, m., in general, 12,
Pl. 17 fig. 3.
in Echidna 13.
— Halmaturus Pl. 13 fig. 1-2.
— Erinaceus 12, Pl. 11 fig. 3.
— Centetes 12, fig. C.
— Talpa 13, Pl. 14 fig. 1, Pl. 15 fig. 1.
— Myogale 13.
— Tapirus 12, 69, Pl. 7, Pl. 8 fig. 2,
Pl. 14 fig. 3.
— Equus 12, 72, Pl. 8 fig. 1.
— Sus 65, Pl. 9.
— Camelus 12, 53, Pl. 5, Pl. 11 fig. 4.
— Cervus canadensis 59, Pl. 11 fig. 5.
— Cervus alces 12, 56, Pl. 11 fig. 1.
— Bos 61.
— Canis 12, Pl. 12.
— Nasua 12, Pl. 11 fig. 2.
— Elephas 30, Pl. 1, Pl. 2, Pl. 4,
Pl. 14 fig. 2, fig. D.
- Membrana nictitans, in Elephas Pl. 3.
- Mentalis Ruge, m. 5.
- Mentalis, m., in general 15, Pl. 17 fig. 3.
in Halmaturus 14, Pl. 13 fig. 3.
— Erinaceus 14.
— Ungulata 14.
— Tapirus 70, Pl. 8 fig. 2.
— Sus 66, Pl. 9.
— Camelus 54, Pl. 5-6.
— Cervus canadensis 60.
— Cervus alces 57.
— Bos 63.
— Canis 14.
— Myopotamus Pl. 14 fig. 4.
— Elephas 38, Pl. 1-4.
- Multifidus, m., in Elephas Pl. 3.

- Nasal bone, in Tapirus Pl. 7, Pl. 8 fig. 2.
- Nasal cavity, in Myopotamus Pl. 14 fig. 4.
- Nasalis Ruge, m. 6.
- Nasalis, m., in general 14, Pl. 17 fig. 3-4.
in Halmaturus 14, Pl. 13 fig. 3.
— Erinaceus 14, Pl. 11 fig. 3.
— Centetes fig. C.
— Talpa Pl. 14 fig. 1, Pl. 15 fig. 1.
— Ungulata 14.
— Tapirus 70, Pl. 7, Pl. 8 fig. 2.
— Equus 72, Pl. 8 fig. 1.
— Sus 66, Pl. 9.
— Camelus 54, Pl. 6.
— Cervus canadensis 60, Pl. 11 fig. 5.
— Cervus alces 57, Pl. 11 fig. 1.
— Bos 63.
— Canis 14.
— Nasua Pl. 11 fig. 2.
— Lepus Pl. 16 fig. 19.
— Elephas 37, Pl. 1-4.
- Nasolabialis, m., in general 11, Pl. 17 fig. 1.
in Echidna 11.
— Didelphys 11, fig. A.
— Halmaturus Pl. 13 fig. 1.
— Centetes 11, fig. B.
— Ungulata 11.
— Tapirus 11, 68, Pl. 7, Pl. 14 fig. 3,
Pl. 16 fig. 27.
— Equus 11, 72, Pl. 16 fig. 26.
— Sus 11, 65, Pl. 9.
— Camelus 11, 52, Pl. 5, Pl. 16 fig. 21.
— Cervus canadensis 59, Pl. 11 fig. 5,
Pl. 16 fig. 24.
— Cervus alces 11, 55, Pl. 11 fig. 1,
Pl. 16 fig. 22.
— Bos 61, Pl. 16 fig. 23.
— Canis 12, Pl. 12.
— Nasua 11, Pl. 11 fig. 2.
— Prosimiae 11.
— Elephas 28, Pl. 1, Pl. 4, Pl. 16
fig. 20.

- Obliqui, mm., in general 20.
in Canis 20, Pl. 12.
- Obliquus inferior, m., in Elephas Pl. 3.
— superior, m., in Elephas Pl. 3.
- Occipitalis Ellenberger-Baum, m.
in Canis 18.

- Omotransversarius, m.
in Halmaturus Pl. 13 fig. 3.
— Sus Pl. 9.
- Orbicularis-oculi-group, in general 10,
Pl. 17, fig. 1.
in Tapirus 68, Pl. 16 fig. 27.
— Equus 72, Pl. 16 fig. 26.
— Sus 64, Pl. 16 fig. 25.
— Camelus 52, Pl. 16 fig. 21.
— Cervus canadensis 58, Pl. 16 fig. 24.
— Cervus alces 55, Pl. 16 fig. 22.
— Bos 61, Pl. 16 fig. 23.
— Elephas 28, Pl. 16 fig. 20.
- Orbicularis oculi Ruge, m. 5.
- Orbicularis oculi, m., in general 10,
Pl. 17 fig. 1.
in Echidna 10, Pl. 10 fig. 1.
— Didelphys fig. A.
— Halmaturus Pl. 13 fig. 1.
— Centetes fig. B.
— Ungulata 10.
— Tapirus 68, Pl. 7, Pl. 16 fig. 27.
— Equus 10, 72, Pl. 8 fig. 1, Pl. 16
fig. 26.
— Sus 64, Pl. 9, Pl. 16 fig. 25.
— Camelus 10, 52, Pl. 5, Pl. 16 fig. 21.
— Cervus canadensis 10, 58, Pl. 16
fig. 24.
— Cervus alces 10, 55, Pl. 16 fig. 22.
— Bos 10, 61, Pl. 16 fig. 23.
— Canis Pl. 12, Pl. 15 fig. 2.
— Elephas 28, Pl. 1, Pl. 16 fig. 20.
- Orbicularis oris, m. 15.
— Ruge, m. 6.
- Orbito-auricularis Ruge, m. 6.
- Organon Jacobsonii, in Myopotamus
Pl. 14 fig. 4.
- Panniculus carnosus Watson 27.
- Parotis
in Halmaturus Pl. 13 fig. 2.
— Tapirus Pl. 7.
— Camelus Pl. 5.
— Cervus alces Pl. 15 fig. 6.
— Canis Pl. 12.
— Elephas Pl. 1.
- Parotideus, ductus
in Halmaturus Pl. 13 fig. 3.
— Tapirus Pl. 8 fig. 2.
— Equus Pl. 8 fig. 1.
— Camelus Pl. 6.
— Bos 62.
— Elephas Pl. 1-4.
- Pars principalis platysmatis
in Ungulata 9.
— Tapirus 9, 27.
— Equus 27.
— Sus 9, 27.
— Camelus 9, 27.
— Cervus canadensis 27.
— Cervus alces 9, 27.
— Bos 9, 27.
— Elephas 27.
- Pars rimana m. buccinatorii, in general 15,
Pl. 17 fig. 3.
in Halmaturus 13, Pl. 13 fig. 1-2.
— Centetes fig. C.
— Ungulata 14.
— Tapirus 70, Pl. 7, Pl. 8 fig. 2,
Pl. 14 fig. 3, Pl. 16 fig. 9.
— Equus 14, 72, Pl. 8 fig. 1, Pl. 16
fig. 12.
— Sus 66, Pl. 9, Pl. 16 fig. 15.
— Camelus 53, Pl. 5, Pl. 6, Pl. 11
fig. 4, Pl. 16 fig. 1.
— Cervus canadensis 14, 60, Pl. 11
fig. 5, Pl. 16 fig. 5.
— Cervus alces 56, Pl. 11 fig. 1,
Pl. 16 fig. 3.
— Bos 14, 62, Pl. 16 fig. 7.
— Canis Pl. 12.
— Elephas 36, Pl. 1, Pl. 4, Pl. 14
fig. 2, Pl. 14 fig. 9, Pl. 16 fig. 16.
- Pars supralabialis m. buccinatorii, in ge-
neral 15, Pl. 17 fig. 4.
in Halmaturus 13, Pl. 13 fig. 3.
— Ungulata 14.
— Tapirus 70, Pl. 8 fig. 2, Pl. 16 fig. 9.
— Equus 72, Pl. 16 fig. 12.
— Sus 66.
— Camelus 54, Pl. 6, Pl. 11 fig. 4,
Pl. 16 fig. 2.
— Cervus canadensis 60, Pl. 16 fig. 6.

- in Cervus alces 57, Pl. 16 fig. 4.
— Bos 62, Pl. 16 fig. 8.
— Canis 14.
— Elephas 37, Pl. 2, Pl. 3, Pl. 14
fig. 2, Pl. 14 fig. 10.
- Pars transiens m. scularis
in Didelphys 20, Pl. 15 fig. 3, fig. A.
— Halmaturus Pl. 13 fig. 1-2.
— Placental Mammals with a scu-
tellum 16, Pl. 15 fig. 4.
— Centetes 22.
— Tapirus Pl. 7.
— Sus 17, Pl. 9.
— Camelus Pl. 5.
— Canis Pl. 12.
— Elephas 44, Pl. 1, Pl. 15 fig. 7.
- Pars zygomatica platysmatis, in general
Pl. 17 fig. 1.
in Ungulata 9.
— Tapirus 9, 67, Pl. 7.
— Equus 71.
— Sus 64, Pl. 9.
— Camelus 9, 51, Pl. 5.
— Cervus canadensis 58.
— Cervus alces 9, 51.
— Bos 61.
— Elephas 27, Pl. 1.
- Periorbita, in Elephas Pl. 3.
- Platysma, in general 8, 23, Pl. 17 fig. 1.
in Echidna 9, 22, 23, Pl. 10 fig. 1-2.
— Ornithorhynchus 9.
— Didelphys 9, 20, Pl. 15 fig. 3,
fig. A.
— Halmaturus 9, Pl. 13 fig. 1-2.
— Centetes 9, fig. B.
— Ungulata 9.
— Tapirus 9, 66, Pl. 7.
— Equus 71.
— Sus 9, 64, Pl. 9, Pl. 10 fig. 3.
— Camelus 9, 51, Pl. 5.
— Cervus canadensis 58.
— Cervus alces 9, 54.
— Bos 9, 60.
— Canis 9, Pl. 12.
— Myopotamus 9.
— Primates 9.
— Elephas 25, Pl. 1, Pl. 4.
- Platysma myoides, Ruge 5.
— Miall and Green-
wood 28.
- Platysma-sphincter-group, in general 6.
in Tapirus 66.
— Equus 71.
— Sus 63.
— Camelus 51.
— Cervus canadensis 58.
— Cervus alces 54.
— Bos 60.
— Elephas 25.
- Portio auricularis m. sphincteris pro-
fundi, in general 7, Pl. 15 fig. 4,
Pl. 17 fig. 1-2.
in Halmaturus 7, Pl. 13 fig. 1-2.
— Centetes 7, fig. C.
— Ungulata 8.
— Tapirus 8, 67, Pl. 7.
— Equus 8, 71.
— Sus 8, 64, Pl. 9, Pl. 10 fig. 3.
— Camelus 8, 51, Pl. 5.
— Cervus Aristotelis 8.
— Cervus canadensis 8, 58.
— Cervus alces 8, 55, Pl. 15 fig. 6.
— Bos 8, 61.
— Canis 7, Pl. 12, Pl. 15 fig. 2,
Pl. 15 fig. 5.
— Lepus 7.
— Myopotamus 8.
— Elephas 25, 45, Pl. 1, Pl. 15 fig. 7.
- Portio inferior m. maxillo-labialis, in ge-
neral 12.
- Portio intermedia m. sphincteris pro-
fundi, in general 7, Pl. 17 fig. 2.
in Halmaturus Pl. 13 fig. 2.
— Canis 7, Pl. 15 fig. 2.
- Portio oris m. sphincteris profundi,
in general 7, Pl. 17 fig. 1-2.
in Canis 7, Pl. 12, Pl. 15 fig. 2.
— Lepus 7.
- Portio palpebralis m. sphincteris pro-
fundi, in general 7, Pl. 17 fig. 1-2.
in Halmaturus 8, Pl. 13 fig. 1-2.
— Centetes 8, fig. C.
— Ungulata 8.
— Tapirus 8, 68, Pl. 7, Pl. 8 fig. 2.

- in Equus 8, 71, Pl. 8 fig. 1.
— Sus 8, 64, Pl. 9.
— Camelus 8, 51, Pl. 5.
— Cervus aristotelis 8.
— Cervus canadensis 8, 58.
— Cervus alces 8, 55.
— Bos 8, 61.
— Canis 7, Pl. 12, Pl. 15 fig. 2.
— Lepus 7.
- Portio postauricularis platysmatis
in Echidna 9, Pl. 10 fig. 1.
- Portio preauricularis platysmatis
in Echidna 9, Pl. 10 fig. 1-2.
- Portio superior m. maxillo-labialis, in
general 12.
in Erinaceus 12, Pl. 11 fig. 3.
— Centetes 12, fig. C.
— Tapirus 12, 69, Pl. 8 fig. 2.
— Equus 12, 72, Pl. 8 fig. 1.
— Camelus 12, Pl. 11 fig. 4.
— Cervus alces 12, 56, Pl. 11 fig. 1.
- Postauricularis, m.
in Didelphys 20, Pl. 15 fig. 3, fig. A.
— Halmaturus 21, Pl. 13 fig. 1-2.
— Placental Mammals with a scu-
tellum 18, Pl. 15 fig. 4.
— Centetes 22, fig. B, fig. C.
— Tapirus 18, Pl. 7.
— Equus 18.
— Sus 18.
— Cervus alces 18, Pl. 15 fig. 6.
— Bos 18.
— Canis 18, Pl. 12, Pl. 15 fig. 5.
— Lepus 18.
— Elephas 44, Pl. 15 fig. 7.
- Posteri septimi, m.
in Halmaturus 21, Pl. 13 fig. 1-2.
— Placental Mammals with a scu-
tellum 19, Pl. 15 fig. 4.
— Sus 19, Pl. 9.
— Canis 19.
— Lepus 19.
- Postorbicularis, m., in general 10, Pl. 17
fig. 1.
in Didelphys 10, fig. A.
— Halmaturus Pl. 13 fig. 1.
— Centetes 10, fig. B.
— Tapirus 10, 68, Pl. 7, Pl. 16
fig. 27.
— Equus 10, 72, Pl. 16 fig. 26.
— Sus 64, Pl. 9, Pl. 16 fig. 25.
— Camelus 52, Pl. 5, Pl. 16 fig. 21.
— Bos 61, Pl. 16 fig. 23.
— Canis Pl. 12.
— Elephas 28, Pl. 1, Pl. 16 fig. 20.
- Proboscis 47.
in Erinaceus 48.
— Centetes 48.
— Talpa 48, Pl. 14 fig. 1, Pl. 17 fig.
10-11.
— Myogale 48.
— Macroscelides 48, Pl. 17 fig. 8.
— Tapirus 49, Pl. 14 fig. 3, Pl. 17
fig. 13.
— Sus 48.
— Nasua 48, Pl. 17 fig. 7.
— Elephas 49, Pl. 14 fig. 2, Pl. 17
fig. 14.
- Præorbicularis, m., in general 10, Pl. 17
fig. 1.
in Echidna 10, Pl. 10 fig. 1.
— Didelphys fig. A.
— Halmaturus Pl. 13 fig. 1.
— Centetes fig. B.
— Tapirus 68.
— Equus 11, 72, Pl. 8 fig. 1, Pl. 16
fig. 26.
— Sus 65, Pl. 9.
— Camelus 52, Pl. 5, Pl. 16 fig. 21.
— Cervus canadensis 59.
— Cervus alces 55.
— Bos 61.
— Elephas 28.
- Præorbicularis dorsalis, m., in general 11,
Pl. 17 fig. 1.
in Tapirus 68, Pl. 7, Pl. 16 fig. 27.
— Equus 11, 72.
— Sus 65, Pl. 16 fig. 25.
— Cervus canadensis 11, 59, Pl. 16
fig. 24.
— Cervus alces 55, Pl. 16 fig. 22.
— Bos 11, 61, Pl. 16 fig. 23.
— Elephas 28, Pl. 1, Pl. 4, Pl. 16
fig. 20.

Præorbicularis ventralis, m., in general 11, Pl. 17 fig. 1.
 in *Didelphys* 11, fig. A.
 — *Centetes* 11, fig. B.
 — *Tapirus* 68, Pl. 7, Pl. 16 fig. 27.
 — *Equus* 11.
 — *Sus* 65, Pl. 16 fig. 25.
 — *Cervus canadensis* 59, Pl. 16 fig. 24.
 — *Cervus alces* 11, 55, Pl. 16 fig. 22.
 — *Bos* 11, 61, Pl. 16 fig. 23.
 — *Elephas* 28, Pl. 1, Pl. 4, Pl. 16 fig. 20.

Rectus buccæ, m., in *Elephas* 43.

Rectus capitis anterior, m.
 in *Elephas* Pl. 3.

Rectus capitis lateralis, m.
 in *Elephas* Pl. 2–3.

Rectus capitis posterior major, m.
 in *Elephas* Pl. 3.

Rectus capitis posterior minor, m.
 in *Elephas* Pl. 3.

Rectus labii, m., in general 16.
 in *Tapirus* 70, Pl. 8 fig. 2.

— *Camelus* 54.

— *Cervus canadensis* 60.

— *Bos* 63.

— *Canis* Pl. 12.

Rectus nasi, m., general 16.
 in *Tapirus* 70, Pl. 7, Pl. 8 fig. 2,
 Pl. 14 fig. 3.

— *Equus* 16.

— *Camelus* 16, 54, Pl. 6.

— *Cervus canadensis* Pl. 11 fig. 5.

— *Cervus alces* 16, 58, Pl. 11 fig. 1.

— *Canis* Pl. 12.

— *Elephas* 31, 40, Pl. 2, Pl. 3,
 Pl. 14 fig. 2, Pl. 14 fig. 5–8, fig. D.

Rectus oculi superior, m.

in *Elephas* Pl. 3.

Rhomboideus, m.

in *Halmaturus* Pl. 13 fig. 3.

Rotator, m., in general 17.

in *Tapirus* 17.

— *Equus* 17.

— *Bos* 17.

— *Canis* Pl. 15 fig. 5.

— *Elephas* 44, Pl. 15 fig. 7.

Scalenus anterior, m., in *Elephas* Pl. 2–3.

Scutellum 16, 18, 21, Pl. 15 fig. 4.

in *Sus* Pl. 9.

— *Camelus* Pl. 5.

— *Canis* Pl. 12, Pl. 15 fig. 5.

— *Elephas* 43, 44.

Scutularis, m.

in *Didelphys* 20, Pl. 15 fig. 3, fig. A.

— *Halmaturus* 21, Pl. 13 fig. 1–2.

— Placental Mammals with a scu-

tellum 16, Pl. 15 fig. 4.

— *Erinaceus* Pl. 11 fig. 3.

— *Centetes* 22, fig. B–C.

— *Tapirus* 17, Pl. 7.

— *Sus* 17, Pl. 9.

— *Camelus* Pl. 5.

— *Cervus alces* 17.

— *Canis* 17, Pl. 12, Pl. 15 fig. 5.

— *Lepus* 17.

— *Elephas* 43, Pl. 1, Pl. 15 fig. 7.

Scutularis, m., pars antero-ventralis

in *Canis* 17, Pl. 12.

Scutularis-group, in general 23.

in Placental Mammals with a scu-

tellum 16.

— *Elephas* 43.

Serratus magnus, m., in *Elephas* Pl. 2.

Sinus hairs

in *Talpa* Pl. 14 fig. 1.

— *Tapirus* Pl. 14 fig. 3.

— *Myopotamus* Pl. 14 fig. 4, 5.

— *Elephas* 26.

Skin of Elephas 25.

Snout

in *Equus* 47.

— *Cervus elaphus* 47.

— *Tragulus* 47, Pl. 17 fig. 9.

— *Capra* 47.

— *Canis* 47, Pl. 17 fig. 5.

— *Procyon lotor* 47.

— *Meles* 48, Pl. 17 fig. 6.

— *Lemur* 47.

— *Homo* 47, Pl. 17 fig. 12.

Sphincter colli 23.

— — —, Ruge 5.

Sphincter profundus, m., in general 7,

Pl. 17 fig. 1–2.

in *Echidna* 8, Pl. 10 fig. 1–2.

— *Ornithorhynchus* 8.

— *Halmaturus* 7, Pl. 13 fig. 1–2.

in *Centetes* 7, fig. C.

— *Ungulata* 8.

— *Tapirus* 8, 67, Pl. 7.

— *Equus* 8, 71.

— *Sus* 64, Pl. 9, Pl. 10 fig. 3.

— *Camelus* 51, Pl. 5.

— *Cervus canadensis* 58.

— *Cervus aristotelis* 8.

— *Cervus alces* 8, 54, Pl. 15 fig. 6.

— *Bos* 61.

— *Canis* 7, Pl. 12, Pl. 15 fig. 2.

— *Lepus* 7.

— *Myopotamus* 8.

— *Prosimiæ* 7.

— *Elephas* 25, 45, Pl. 1, Pl. 15 fig. 7.

Sphincter superficialis, m., in general 6,

Pl. 17 fig. 1.

in *Echidna* 6, Pl. 10 fig. 1–2.

— *Ornithorhynchus* 6.

— *Marsupialia* 7.

— *Centetes* 6, fig. B.

— *Ungulata* 7.

— *Tapirus* 66.

— *Equus* 71.

— *Sus* 7, 63, Pl. 9, Pl. 10 fig. 3.

— *Camelus* 51.

— *Lama* 51.

— *Cervus canadensis* 58.

— *Cervus alces* 54.

— *Bos* 60.

— *Canis* 7, Pl. 12.

— *Myopotamus* 7.

— *Prosimiæ* 7.

— *Primates* 7.

Splenius, m.

in *Halmaturus* Pl. 13 fig. 3.

— *Elephas* Pl. 2–3.

Sternocleidomastoideus, m.

in *Halmaturus* Pl. 13 fig. 3.

Sternohyoideus, m.

in *Halmaturus* Pl. 13 fig. 3.

Supraorbicularis, m., in general 11,

Pl. 17 fig. 1.

in *Tapirus* 11, 68, Pl. 7, Pl. 16 fig. 27.

— *Equus* 11, 72, Pl. 8 fig. 1, Pl. 16

fig. 26.

— *Sus* 11, 65, Pl. 9, Pl. 16 fig. 25.

— *Camelus* 11, 52, Pl. 5, Pl. 16 fig. 21.

— *Cervus canadensis* 59, Pl. 16 fig. 24.

— *Cervus alces* 11, 55, Pl. 16 fig. 22.

in *Bos* 11, 61, Pl. 16 fig. 23.

— *Elephas* 29, Pl. 1, Pl. 4.

Temporalis, m.

in *Talpa* Pl. 15 fig. 1.

— *Tapirus* Pl. 7.

— *Elephas* Pl. 1–4.

Temporo-auricularis, m.

in *Didelphys* 21.

— *Halmaturus* 21, Pl. 13 fig. 2–3.

— *Centetes*, 22, fig. B–C.

— *Equus* 19.

— *Sus* 19, Pl. 9.

— *Cervus alces* 19.

— *Canis* 19, Pl. 15 fig. 5.

— *Lepus* 19.

— *Elephas* 45, Pl. 1, Pl. 15 fig. 7.

Trachelo-mastoideus, m.

in *Elephas* Pl. 2–3.

Tragicus, m. 19.

in *Homo* 20.

Trago-antenus, m.

in *Halmaturus* 21.

— *Canis* 20, Pl. 12, Pl. 15 fig. 5.

— *Lepus* 20.

Trago-antitragicus Ruge, m. 5.

Transversi, mm., in general 20.

in *Tapirus* Pl. 7.

— *Canis* Pl. 12.

— *Elephas* 46, Pl. 15 fig. 7.

Transversus nasi, m., in *Equus* 16, 39,

74, Pl. 8 fig. 1.

— — — profundus Günther,

m., in *Equus* 74.

— — — superficialis Günther,

m., in *Equus* 74.

Trapezius, m.

in *Sus* Pl. 9.

— *Elephas* Pl. 2.

Trigeminus, n.

in *Talpa* Pl. 14 fig. 1, Pl. 15 fig. 1.

— *Tapirus* Pl. 14 fig. 3.

X, m., in *Elephas* 46, Pl. 2.

Zygomatico-labialis, m., in *Elephas* 28.

Zygomaticus, m. 9, 17.

ERRATUM.

Pag. 17, line 37: after the word »Tapir« add: Camel.

Pag. 12, line 17 the words »front part of sphincter
 prof.« should be omitted.

EXPLANATION

OF

PLATE 1.

Superficial muscles of right side of the *Elephants* head. Half natural size.

a—e platysma, *a—c* mandibular, *d—e* angular portion; *e* pars zygomatica platysmatis. *f* its aponeurosis. *fl* fat, *gl* large cutaneous gland, *o* the cavity of the gland. To the left of the gland is seen an artery (red) and a venous plexus (blue). *z* zygoma.

1—4 m. scutularis, *3* pars transiens, *6* m. auriculo-occipitalis, *11* m. adductor inferior, *12* portio auricularis m. sphincteris profundi, *13* m. temporo-auricularis, *14* m. anteri sexti.

EXPLANATION

OF

PLATE 2.

The head of the *Elephant* from the right after removal of the superficial muscles shown in Plate 1. Half natural size.

a transverse, *b—c* longitudinal layer of m. buccinatorius.

EXPLANATION

OF

PLATE 3.

The head of the *Elephant* from the right after removal of most of the facial muscles, the eyelids, the zygoma, the masseter etc. Half natural size.

c	—	insertion of m. complexus
m ₁ —m ₃	—	- the different parts of m. masseter
os	—	- m. obliquus superior
s ₁ —s ₂	—	- - splenius
t	—	- - trachelo-mastoideus

EXPLANATION

OF

PLATE 4.

Fore part of head of the *Elephant* seen from the left side; most of platysma has been taken away. c. $\frac{4}{5}$.

EXPLANATION

OF

PLATE 5.

Superficial facial muscles of *Dromedary*.

EXPLANATION

OF

PLATE 6.

Head of the same *Dromedary* which is figured in Pl. 5, after removal of most of the facial muscles. The figure illustrates in the first instance the deep, longitudinal layer of m. buccinatorius and the pars supralabialis of the same; the superficial, transverse layer of m. buccinatorius having been removed. The red spots above the narial aperture are rectus-bundles cut through.

x are muscular fascicles lying near the mucous nasal membrane (perhaps rectus-bundles?).

EXPLANATION

OF

PLATE 7.

Superficial facial muscles of a *Tapir* (*Tapirus americanus*). Most of the external ear has been cut off. —
a, b, c see the text p. 67.

EXPLANATION

OF

PLATE 8.

Fig. 1. Deeper facial muscles of anterior part of the head of a *Horse*.

Fig. 2. Deeper facial muscles of anterior part of the head of the *Tapir*, which is figured Pl. 7. — The red spots seen in the lower lip are the cut ends of mentalis-fibres.

EXPLANATION

OF

PLATE 9.

Superficial facial muscles of *Wild Boar*. Above the longitudinal section of the skin the thick layer of woolly hairs is seen and above these the ends of the bristles representing the contour hairs in this animal.

EXPLANATION

OF

PLATE 10.

Fig. 1. Superficial facial muscles of *Echidna* from the right side. The specimen figured has accidentally raised the snout very much.

Fig. 2. The same specimen turned so that it is seen more from the ventral side, after removal of a large part of the m. sphincter superficialis, whose connection with the m. sphincter profundus is distinctly seen.

Fig. 3. Hinder part of head of the same *Boar* as figured in Pl. 9. It is seen somewhat more from the ventral side. The upper end of the m. sphincter superficialis and the hinder end of platusma have been removed. Of the muscles only the sphincteres and the platusma have been represented in colours.

EXPLANATION

OF

PLATE 11.

Fig. 1. Fore end of head (mandible omitted) of *Elk* with the *m. maxillo-labialis* etc. Most of the *m. nasolabialis* etc. dissected away.

Fig. 2. Fore end of head of *Nasua* with the *m. maxillo-labialis*, *m. nasolabialis* and *m. nasalis*.

Fig. 4. Fore end of head (mandible omitted) of *Dromedary* with the *m. maxillo-labialis* etc. The *m. nasolabialis* and most of *pars rimana* are dissected away.

Fig. 5. Fore end of head (mandible omitted) of *Wapiti*. Most of *m. nasolabialis* dissected away. — *a, b, c* vide p. 59. The red spots behind the narial aperture are the ends of rectus-bundles.

Fig. 3. Fore end of head of *Erinaceus* with the *m. maxillo-labialis*.

EXPLANATION

OF

PLATE 12.

¹⁾ continued into the adjoining slip of m. postauricularis.

Superficial facial muscles of *Canis lupus*. — The small red spots on the snout are cut fascicles of m. rectus labii et nasi.

EXPLANATION

OF

PLATE 13.

Fig. 1. Superficial facial muscles of *Halmaturus*.

Fig. 2. Facial muscles of the same after removal of platisma, m. postorbicularis and m. nasolabialis.

Fig. 3. The same head after removal of the m. sphincter profundus, the orbicularis-complex, the m. maxillo-labialis, most of the ear-muscles, part of masseter etc. On the neck the m. trapezius has been removed. — The m. temporo-auricularis is seen more completely than in fig. 2, where it is partly covered by the fascia of m. sphincter profundus.

The red spots above the m. nasalis are the ends of nasalis- and rectus-bundles.

EXPLANATION

OF

PLATE 14.

Fig. 1. Transverse section of the proboscis of *Talpa*. Cartilage and tendons are painted with various blue tints, glands and nerves with yellow, muscular fibres redbrown. The redbrown sinuous streaks are transverse *nasalis*-fibres.

Fig. 4. Transverse section of anterior part of the head of *Myopotamus*. *a* part of *m. buccinatorius* inserting into the intermaxillary bone; *b* part of the same surrounding the cavity of mouth. The brown patches in the upper part of the figure are hair-follicles of sinus-hairs.

Fig. 2. Transverse section of proboscis of *Indian Elephant*. In order that the various muscles might easier be distinguished the *pars rimana* and the rectus-bundles have been painted with another red tint than have the maxillo-labialis and the supra-labialis.

Fig. 3. Transverse section through proboscis of *Tapirus americanus*. The inferior portion of the *m. maxillo-labialis*, the *m. nasolabialis* and the *pars rimana* form in this place one continuous muscular sheath. The carmine and blue spots are sections of arteries and veins. — *a, b, c* see text p. 71.

Fig. 5–8. Diagrams of the arrangement of the rectus-fascicles in various points of the proboscis of the *Elephant*; transverse sections, the fig. 5 representing the most proximal, the fig. 8 the most distal section. For details see the text p. 40–41. — *n* nasal tube.

Fig. 9. Diagram of the *pars rimana* of *Elephant*; proboscis seen from the ventral side. *i* incisor. See text p. 36.

Fig. 10. Diagram of the *pars supralabialis* of *Elephant*; proboscis seen from the ventral side, *i* incisor. See text p. 37.

Fig. 11. Part of skull etc. of *Elephant* with the *musculus lateralis nasi*.

EXPLANATION

OF

PLATE 15.

Fig. 1. Head of *Talpa*, with the *m. maxillo-labialis* dissected out. Round the ear-opening and the eye a little skin has been left. The right fore-limb has been exarticulated in the elbow-joint.

Fig. 2. Head of *Greenland Dog*, with the *m. sphincter profundus* dissected out. To the left is seen the *portio auricularis*, then follows the *portio intermedia*, then the *portio palpebralis*, some of whose fascicles are transversely interrupted; finally the *portio oris*, extending into the upper and lower lip. Of the other muscles only the orbicularis oculi has been indicated.

Fig. 3. Head of *Didelphys*, seen from above, with the *ear-muscles* dissected out. *p. anterior*, *p. intermedia* etc. = pars anterior etc. musculi auriculo-occipitalis + postauricularis. *scutularis a* see the text p. 20.

Fig. 4. Diagram of the *ear-muscles* of the right side of the Placental Mammals. Most of the auricle has been cut off. *s* scutellum. *sphincter prof.* = pars auricularis *m. sphinct. prof.*

Fig. 5. Muscles of the right ear of *Canis lupus* dissected off from the head and seen from the internal side. *s* scutellum; the margin of this, as far as covered by muscles, is indicated by a dotted line. *la* musculus trago-antennae. — Comp. Pl. 12.

Fig. 6. Head of *Elk*, seen from behind; the neck has been cut through near the head; the parts seen in the section have only been indicated (*a* atlas, *c* carotis, *e* ligamentum nuchae, *m* medulla spin., *o* proc. odont. epistrophæi, *oe* oesophagus), the figure having the aim to show the relations of some of the ear-muscles.

Fig. 7. Right ear of the *Elephant* with its muscles dissected off from the head and seen from the internal side. 1—4 *m. scutularis*, 3 pars transiens, 1 tendinous band. 5 *m. rotator*. 6 *m. auriculo-occipitalis*. 7 another portion of the same, cut off near the insertion. 8 and 9 *m. postauricularis*, superficial part, cut off. 10 *m. postauricularis*, deep portion, most of it omitted. 11 *m. adductor inf.* 12 *m. sphincter profundus*, pars auricularis. 13 *m. temporo-auricularis*. 15 *m. transversus* (15* see the text p. 46).

EXPLANATION

OF

PLATE 16.

Fig. 1—15. Diagrams of *Musculus buccinatorius* of various *Ungulates*.

1. Camel.
2. — , deep, longitudinal layer.
3. Elk.
4. — , deep, longitudinal layer.
5. Wapiti.
6. — , deep, longitudinal layer.
7. Zebu.
8. — , deep, longitudinal layer (intermediate).
9. Tapir.
10. — , deep, longitudinal layer (intermediate).
11. — , deepest layer.
12. Horse.
13. — , deep, longitudinal layer (intermediate).
14. — , deepest layer.
15. Swine.

Fig. 16. Diagram of *M. buccinatorius* of the *Elephant*.

Fig. 17. — - — of the *Dog*.

Fig. 18. — - — of the *Hedgehog*.

Fig. 19. — - — of the *Rabbit* (*a*, *b*, *c* see the text p. 15).

Fig. 20. *Orbicularis-oculi-group* on the left side of *Elephant*.

Fig. 21—27. Diagrams of *Orbicularis-oculi-group* on the left side of various *Ungulates*.

hor m. horizontalis, *nasol* m. nasolabialis, *po* m. postorbicularis, *pr* m. præorbicularis, *prl* m. præorbicularis dorsalis, *prv* m. præorbicularis ventralis, *sup* m. supraorbicularis.

21. Dromedary. Anterior part of m. nasolabialis omitted.
22. Elk (*prv*₁ and *prv*₂ comp. the text p. 55).
23. Zebu.
24. Wapiti.
25. Swine. M. nasolabialis (comp. Pl. 9) omitted.
26. Horse.
27. Tapir.

EXPLANATION

OF

PLATE 17.

Fig. 1—4. Diagrams of the facial muscles of Mammals, save the muscles of the external ear. 1 the superficial muscles, 2—4 successively deeper muscles. *p. auricul.*, *p. intermedia*, *p. palpebr.* and *p. oris* are the various portions of the *musculus sphincter profundus*.

Fig. 5—14. Diagrams of sagittal sections of the snout, resp. the proboscis, of various Mammals. The diagrams illustrate the morphology of the proboscis. *i* incisor, *n* nostril, *p* hard palate. The skin round the nares is marked by a broad *black* line, the front side of the upper lip by a *red* one, and the posterior side of the same by a deep *blue* one. The bones are yellow, the cartilage light blue, connective tissue grey. — In the Talpa-foetus (fig. 11) the portion of the skin marked by the red line has still a vertical, not a horizontal position as in the adult (fig. 10). — Comp. for the other figures the text p. 47—50.

591/66
B66
Mammals
FOL
737
P98866
1908
pt.1
Mamm

J. E. V. BOAS & SIMON PAULLI

THE
ELEPHANT'S HEAD

STUDIES IN THE COMPARATIVE
ANATOMY OF THE ORGANS OF THE
HEAD OF THE INDIAN ELEPHANT
AND OTHER MAMMALS

PUBLISHED AT THE COST OF THE CARLSBERG-FUND, COPENHAGEN

FIRST PART
THE FACIAL MUSCLES AND THE PROBOSCIS
WITH SEVENTEEN PLATES IN COLOURS

SOLD BY MR. GUSTAV FISCHER, JENA

1908

SMITHSONIAN INSTITUTION LIBRARIES
3 9088 00718 4203